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CRUZEX 2024
Natal AB / Brazil

FIAT G.91
Piacenza San Damiano Airport /Italy

Boeing B-17G "Sally B"
Duxford Airfield / United Kingdom

LIMA 2025
Langkawi Airport / Malaysia

RAMSTEIN FLAG 2025
Leeuwarden AB / Netherlands

Sukhoi Su-22 Flyout
Mieroslavic AB / Poland

Coverstory:

KILLSWITCH

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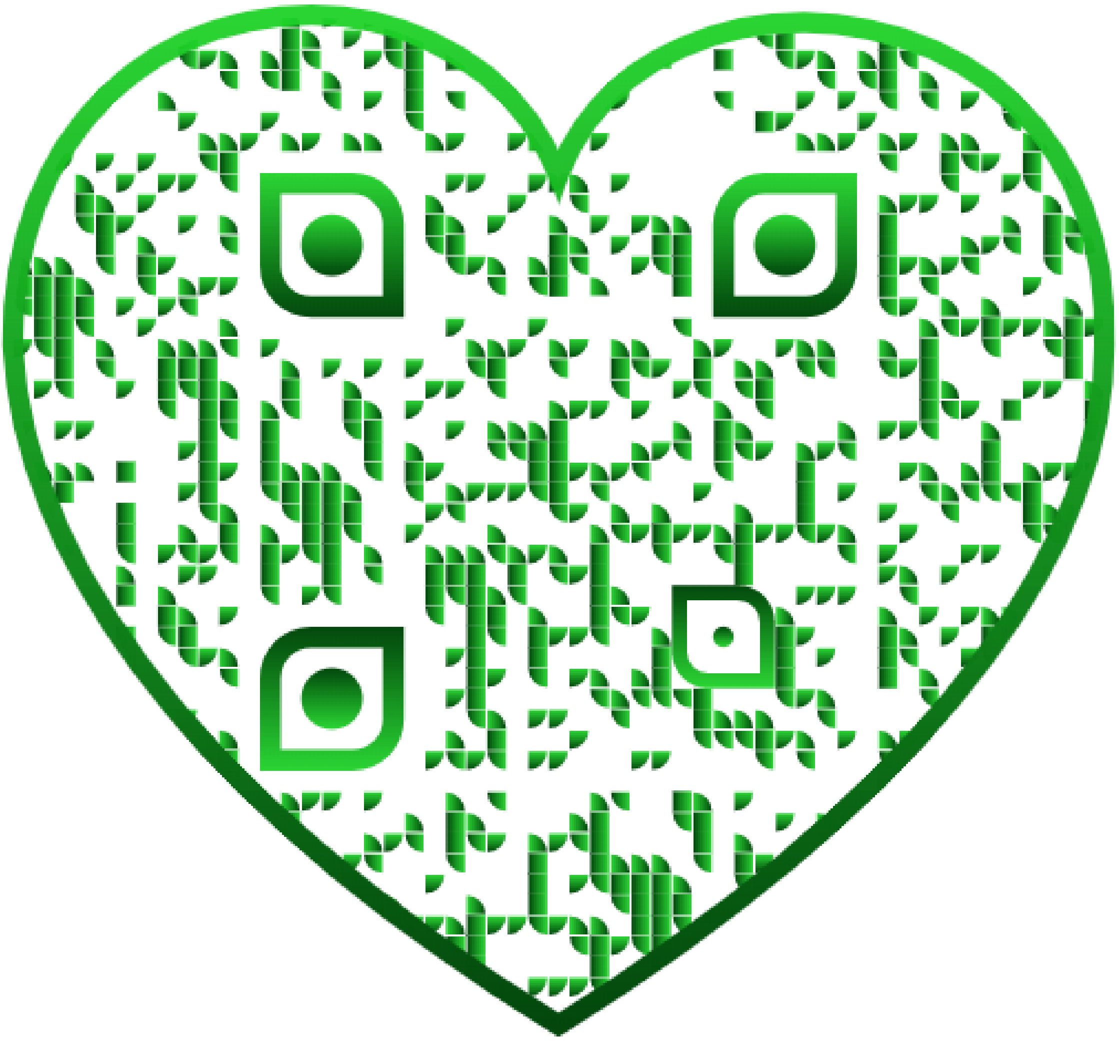

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Contact

Burggaillenreuth 116
D-91320 Ebermannstadt
Germany
phone: +49 (0)177 4867937
mailto: chiefeditor@checksix.de
home: www.checksix-journal.com

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Layout & Design

Team CHK6

Publisher

Robert Kysela

Managing editor

Robert Kysela

Senior editor

Shawn Clish

Italian editor

Danilo Bof

Turkish editor

Özkan Üner

Contributors

Will Moore / UK
Alessandro Ganeo / Italy
Alex van Noiye / Netherlands
Joris van Boven / Netherlands
Bob Barton / UK
Erik Bruijns / UK
...

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contact@checksix.de

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BRIEFING

Things don't always go as planned. Originally, we had intended to publish the second part of our in-depth feature on the FLANKER family in this issue. However, another aircraft from the same Russian design bureau unexpectedly took center stage, the Sukhoi Su-22 FITTER. Still in active service with the Polish Air Force (for now), this Cold War-era legend offered us a rare opportunity: an exclusive look into its daily operational use. Naturally, we couldn't pass up the chance to share these unique insights with you, especially with the Su-22 scheduled to be retired in the near future. As a result, we have decided to postpone the planned continuation of our Su-27/30 feature to one of the next issues. We appreciate your understanding and patience!

The rest of this issue is, once again, packed with fascinating stories, from the nimble FIAT G.91 to the mighty Boeing B-17. You'll also find a wide array of compelling reports covering airshows, military exercises, and a slightly different take on the Lockheed Martin F-35.

chiefeditor@checksix-journal.com

We hope you enjoy reading this issue as much as we enjoyed putting it together for you!

Robert Kysela

CRUZEX - 2024

3 - 15 November 2024

Natal Air Base / Brazil

Embraer A-1AM / *image by: Erik Bruijns*

After a six-year absence, the Força Aérea Brasileira (FAB – Brazilian Air Force) organized once again their largescale war simulation exercise called Cruzeiro do Sul Exercício (CRUZEX – Southern Cross Exercise). The largest multinational air training in Latin America, organized by the Brazilian Air Force since 2002, took place at Natal Air Base, in Rio Grande do Norte from 3 - 15 November 2024. One of the main objectives of CRUZEX is to provide the training opportunities in Joint Air Operations, including Ground Attack, Air Defense, Escort, In-Flight Refueling, Air Alert and Control, Reconnaissance, Combat Rescue, Cargo Drop, and Paratroopers. Different nations working closely together, flying aircraft with different functions and capabilities, acting in an integrated and cooperative manner, allowing for a high operational gain, while also promoting the exchange of experiences among all those involved.

Story & images by: Erik Bruijns

A-1AM
5526

More Objectives

The training enabled the validation of new doctrines and tactics. The Commander of the Natal Air Base, Brigadier General Rezende explained: "The realization of another edition of the largest multinational warfare training in Latin America aims to strengthen interoperability between the Air Forces of different countries, promoting joint training in complex and challenging scenarios capacity of the FAB's squadrons. It is an opportunity, both for FAB service members and for the other 15 participating countries, to add knowledge, enabling experiences in joint action scenarios. The exercise is not intended to highlight the advantages of one force over another, or between aircraft, nor to designate winners or losers. Instead, it provides joint training where each country contributes its knowledge and capabilities to the collective evolution of the forces involved."

History

Until the mid-90s, the operational exercises of the Brazilian Air Force took place only within the national territory, being restricted to training among its own squadrons. This began to change with exercise OPERATIONS TIGER (1994, 1995 and 1997) and exercise MISTRAL (1997 and 1998), carried out in cooperation with the United States Air Force (USAF) and the French Armée de l'Air, respectively. These exercises allowed for the first time to verify the level of training of pilots and the performance of the Embraer A-1 (local designation of the AMX GHIBLI), Northrop F-5 TIGER II and Dassault MIRAGE III fighters of the FAB, against more modern combat aircraft. In 1998, it was the turn of the A-1 jets to participate in RED FLAG, one of the most realistic air drills in the world, at Nellis Air Force Base, in Nevada, in the United States. The subsequent analyses of these meetings showed the

KC-390
FAB
2859

Embraer KC-390 MILLENIUM / *image by: Erik Bruijns* excellence of the training and the innate skills of the Brazilian military pilots. Although it was successful in some clashes, especially the A-1 (with its performance being highly praised), the technological gap and the need for modernization or the acquisition of more capable aircraft for the FAB were also evident, culminating later with the implementation of the F-5BR Program and the launch of the F-X Project. Finally, another conclusion drawn from these exercises with friendly nations was the idea for the planning and organization of a large multinational training within Brazil.

The setup of CRUZEX is based on experience gained by the FAB in their participation in RED FLAG in the US and Tactical Leadership Program (TLP), in Europe. Focused on the realism of the actions, these trainings had as a backdrop the assembly of fictitious scenarios, in which a contested territory was invaded by a certain nation (red country), resulting in the formation of an international coalition, led by the blue country, with the objective of expelling the invader. Using this plot and always attentive to the latest air warfare tactics, the FAB, with the experience acquired in participating in multinational exercises, decided to create its own training along the same lines. Thus, the Cruzeiro do Sul Exercise emerged. The first edition took place in 2002, in the South of Brazil, with the Canoas Air Base, in Rio Grande do Sul, being chosen as the central point of air operations, housing the main air resources of the training. Brazil, Argentina, Chile and France participated with aircraft. Squadrons from Florianópolis and Santa Maria Air Bases were incorporated into the exercise, operating in a split manner. The model of geographical distribution of activities, with an Air Base centralizing operations and other nearby locations integrating the scenario or functioning as support points, would become a trademark of CRUZEX. Two years later, it was the turn to Natal, in Rio Grande do Norte, to host the training, with the participation of Brazil, Argentina, France and Venezuela. The exercise was established on a biennial basis, and so, in 2006, the Anápolis Air Base, in Goiás, received aircraft from six countries, Brazil, Argentina, France, and Venezuela, in addition to the return from Chile and the debut of Uruguay. From 2008, the exercise gained a permanent headquarters, Natal Air Base (BANT), and took place in November, due to the favourable weather at this time of year. One of the main reasons for the choice was the fact that Natal is one of the largest Air Bases of the FAB, with an appropriate infrastructure to host large air trainings. In addition, the base had already hosted Operations TIGRE II and MISTRAL I, in addition to CRUZEX itself, in 2004. Geography also weighed in favour of placing the exercise in the South of Brazil. The State of Rio Grande do Norte, which is located in the Northeast region of Brazil, was closer to North America and Europe, facilitating logistics and the displacement of foreign air assets. The vast airspace with minimum civilian airplane activities adds to the favorable position for the exercise to the held in Natal.

With each edition, CRUZEX has been gaining importance and incorporating new elements, challenges and scenarios, in the always complex and dynamic fields of air warfare and military technology. The numbers are impressive and give the exact dimension of the greatness of the exercise. For the 2024 edition, there were 16 participating countries (half of them actively participating with air assets, equaling the number of the 2013 and 2018 editions), more than three thousand military personnel involved and close to 100 aircraft, from Brazil and foreign nations. Air assets participated from Brazil, Argentina, Chile, Colombia, the United States, Paraguay, Peru and Portugal; with personnel for actions in the Space and Cyber domains coming from Brazil, Chile, Colombia, the United States, Paraguay, and Peru. In addition, observers joined from South Africa, Germany, Canada, Ecuador, France, Italy, Sweden and Uruguay. The 2024 edition marked several important milestones, with participation for the last time of certain types and participation for the very first time of certain types as well as air forces in CRUZEX.

Saab F-39E GRIPEN */ image by: Erik Bruijns*

FAdeA IA-63 PAMPA III */ image by: Erik Bruijns*

CASA 212 AVIOCAR */ image by: Erik Bruijns*

2035
FUERZA AEREA PARAGUAYA

Participants

By far the biggest contributor to the exercise was the FAB. Having started the organization of CRUZEX already back in 2023, many of their participating aircraft came to Natal three weeks earlier to prepare for the exercise. Coming from Santa Maria, in the South of Brazil, were five Embraer AMX International A-1AM/BM aircraft. This will very likely mark the last participation of the type in the exercise as the type is soon to be withdrawn from service. No less than 14 Northrop F-5EM/FM TIGER II's participated during the exercise. With a loss of one of their aircraft during the week leading up to the exercise, the type remained heavily involved in flying activities. The aircraft came from both Canoas Air Base and Santa Cruz Air Base. One of the stars of CRUZEX was the first-time participation of the Saab F-39E GRIPEN, based at Anapolis Air Base. With seven aircraft present during the exercise, the FAB brought almost their entire arsenal of the new fighter, of which the latest are currently being built in Brazil after the first batches coming directly from Sweden. CRUZEX always brings a wide variety of types and countries together. The 2024 edition was not different. The Fuerza Aérea Argentina (FAA – Argentine Air Force) travelled North with four Fabrica Argentina de Aviones (FAdeA) IA-63 PAMPA III advanced training and light attack jets, making their debut. They were supported by a single Lockheed Martin KC-130H HERCULES which also provided air to air refueling during the exercise. Another debutant came from the Fuerza Aérea del Perú (FAP – Peruvian Air Force), which provided five Korea Aerospace Industries (KAI) KA-1P TORITO training and attack turboprop aircraft. Participating for the second time, Peru also provided a KC-130H. More tanker support came from the Fuerza Aérea Colombiana (FAC – Colombian Air Force), providing a single Boeing KC-767 JUPITER.

Returning for the sixth time was the Fuerza Aérea de Chile (FACh – Chilean Air Force) with five Lockheed Martin F-16C/D VIPERs and a single Boeing KC-135E STRATOTANKER. The United States Air Force (USAF) has been a supporter of CRUZEX for a long time and also supported this year's edition. Participating for the first time, six Boeing F-15C EAGLEs arrived from Louisiana supported by a Boeing KC-46A PEGASUS. After participating as observers in previous editions, the Fuerza Aérea Paraguaya (FAP – Paraguayan Air Force) was a welcome new participant. Sending one Casa C-212-400 AVIOCAR and three Embraer AT-27 TUCANOs. It was a big learning curve for these pilots, being able to work closely together with other nations as well as other types of aircraft. Having bought the KC-390 from Brazil, and currently operating two, Força Aérea Portuguesa (FAP - Portuguese Air Force) sent a single KC-390, also marking their first participation. Being able to closely work together with FAB pilots, flying the same type of aircraft is crucial for the FAP, so they can maximize their capabilities of the new aircraft.

Lockheed Martin KC-130H HERCULES / image by: Erik Brujins

FUERZA AEREA ARGENTINA
BAM MALVINAS
TC-70
TC-70

Forca Aérea Brasileira

Based at Natal Air Base, so outnumbering all other participating aircraft, the Embraer A-29A/B SUPER TUCANO participated from all four main squadrons/bases; Natal, Porto Velho, Boa Vista and Campo Grande. Based at Anapolis, the Embraer R-99 and E-99M provided Remote Sensing and Airborne Early Warning and Control (AEW&C) missions. Transport duties were provided by Manaus Air Base and Campo Grande Air Base based Casa C-105A AMAZONAS. A Search and Rescue (SAR) version, SC-105, was also present at Natal, but did not fly during the exercise. Another newcomer and heavily used during its short career was the Embraer (K)C-390 MILLENIUM. The new workhorse of the FAB provided both transport as well as air to air refueling duties. Another end of an era appearance came from two McDonnell Douglas AF-1B/C SKYHAWKs of the Brazilian Navy. With only a handful of these aging aircraft flying, this is very likely their last participation.

A-29B
5966
SALVAMENTO
RESCUE

Embraer A-29A/B SUPER TUCANO / *image by: Erik Bruijns*

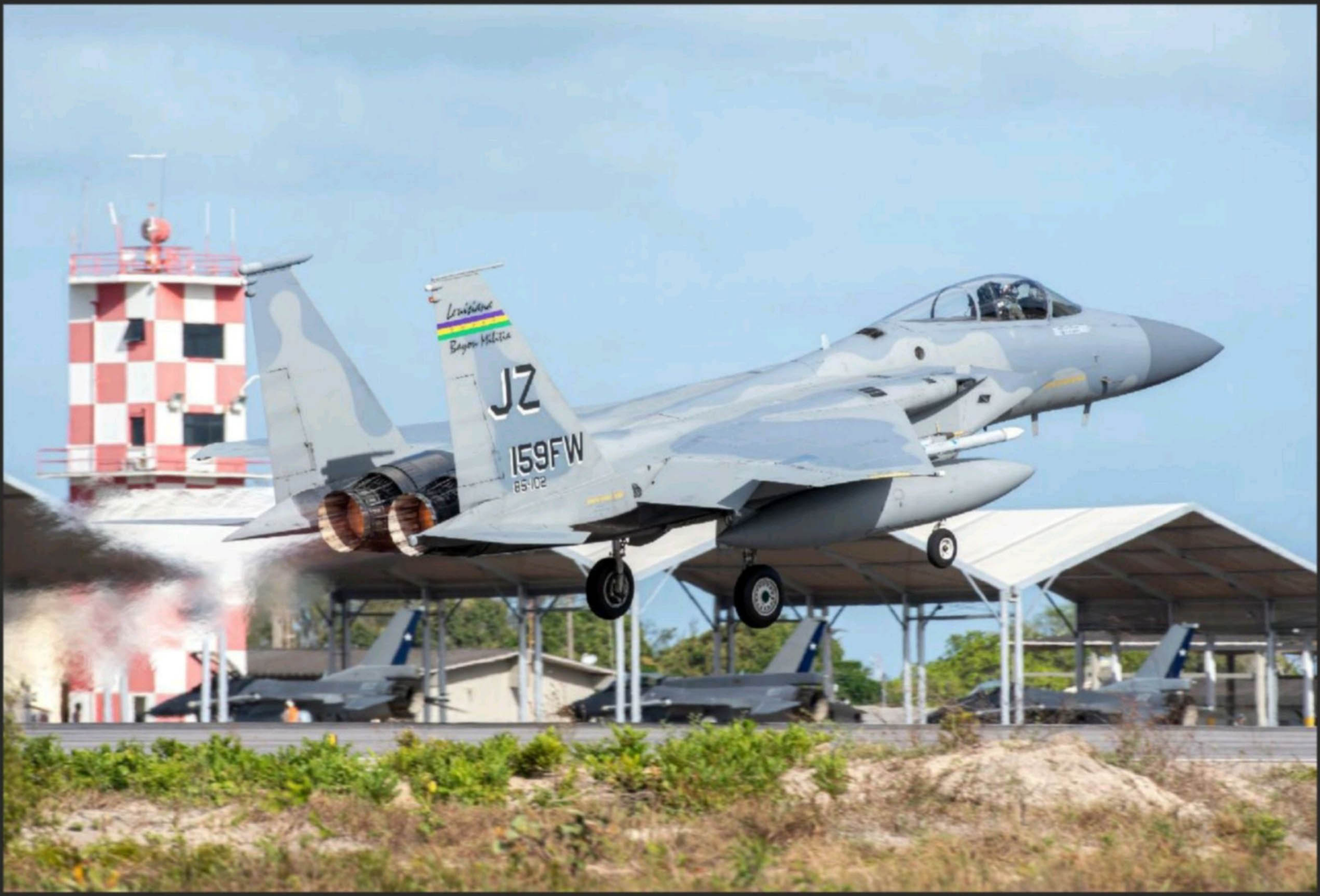
FORÇA AÉREA BRASILEIRA
06

Lockheed Martin F-16C FIGHTING FALCON / image by: Erik Bruijns

The Exercise

The exercise in Natal was divided into three phases. The first, called FAM (Familiarization Mission), included adaptation flights to assist, mainly foreign crews, in acclimatizing to the geographical characteristics of the area of operations, local air traffic and radio frequencies. The second, called FIT (Force Integration Training), promoted joint work among the various participating Air Forces, but in a limited way, employing formations with a smaller number of aircraft. This phase also provided interaction and cooperation among all participants, essential elements for the third and final stage, centered on Composite Air Operations (COMAO) itself, marking the high point of the training.

The second and final week of the exercise were marked by the intensification of activities and included flights in highly complex scenarios, with multiple aircraft involved in air operations, requiring accurate and careful planning and with a level of pressure similar to that of a real conflict. In this phase, the packages involved the participation of more than 60 aircraft, acting simultaneously and in an integrated manner, representing the forces of both sides. The fighters acted in the role of air defense. Their role was to escort and protect the transport, attack, air to air refueling aircraft and the valuable Air Command, Control and Warning aircraft. At the same time, they had the function of locating, engaging and neutralizing their similar opponents, who constituted the great threat to other aircraft. In total, about 1 500 hours were flown and more than 800 missions were accomplished, in favor of constant training, interoperability, and cooperation.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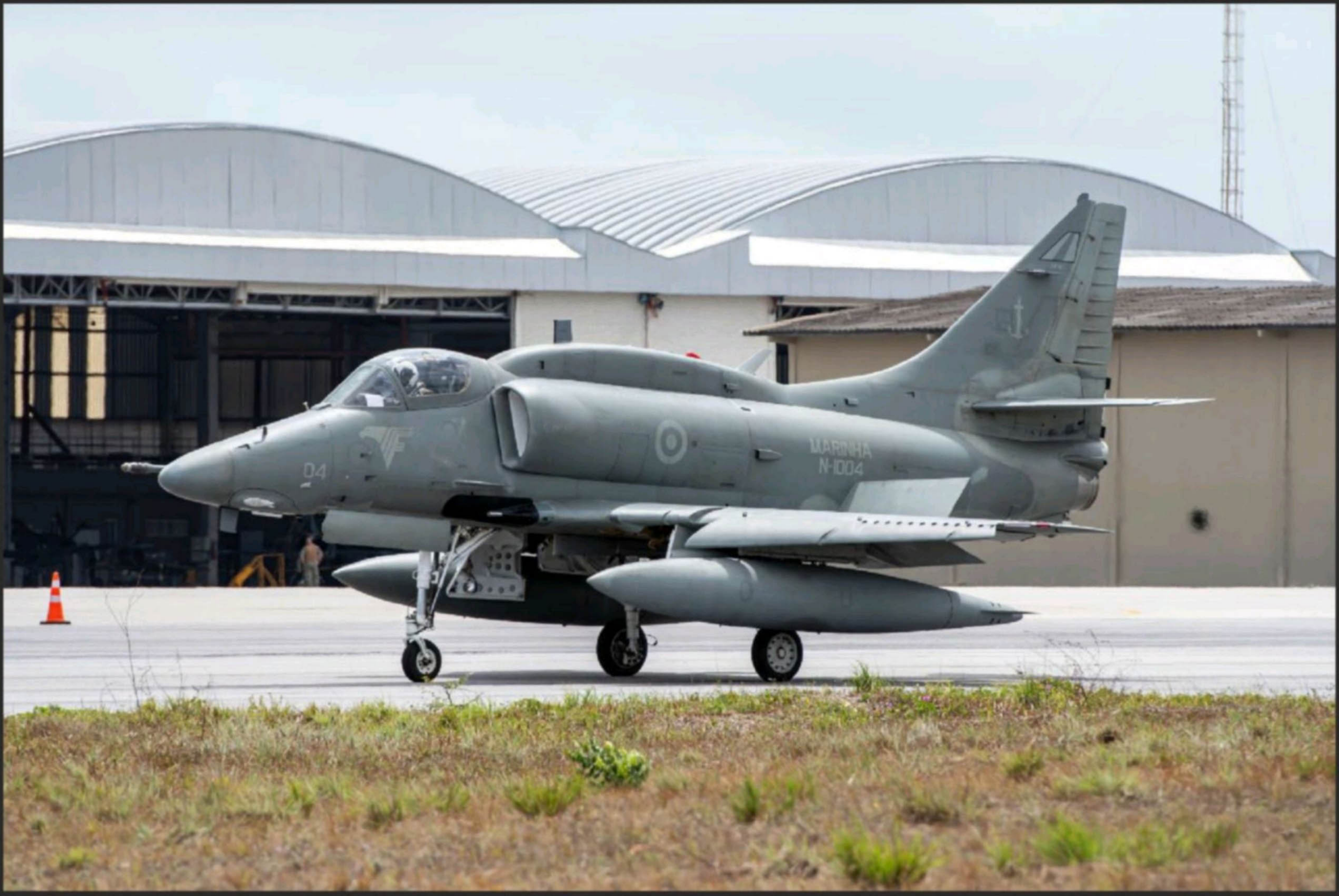
Boeing F-15C EAGLE / image by: Erik Bruijns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McDonnell Douglas A-1B / image by: Erik Bruijns

C-105
2800
FORÇA AEREA BRASILEIRA
SALVAMENTO
RESCUE

Northrop F-5EM TIGER II / image by: Erik Bruijns

Verdict:

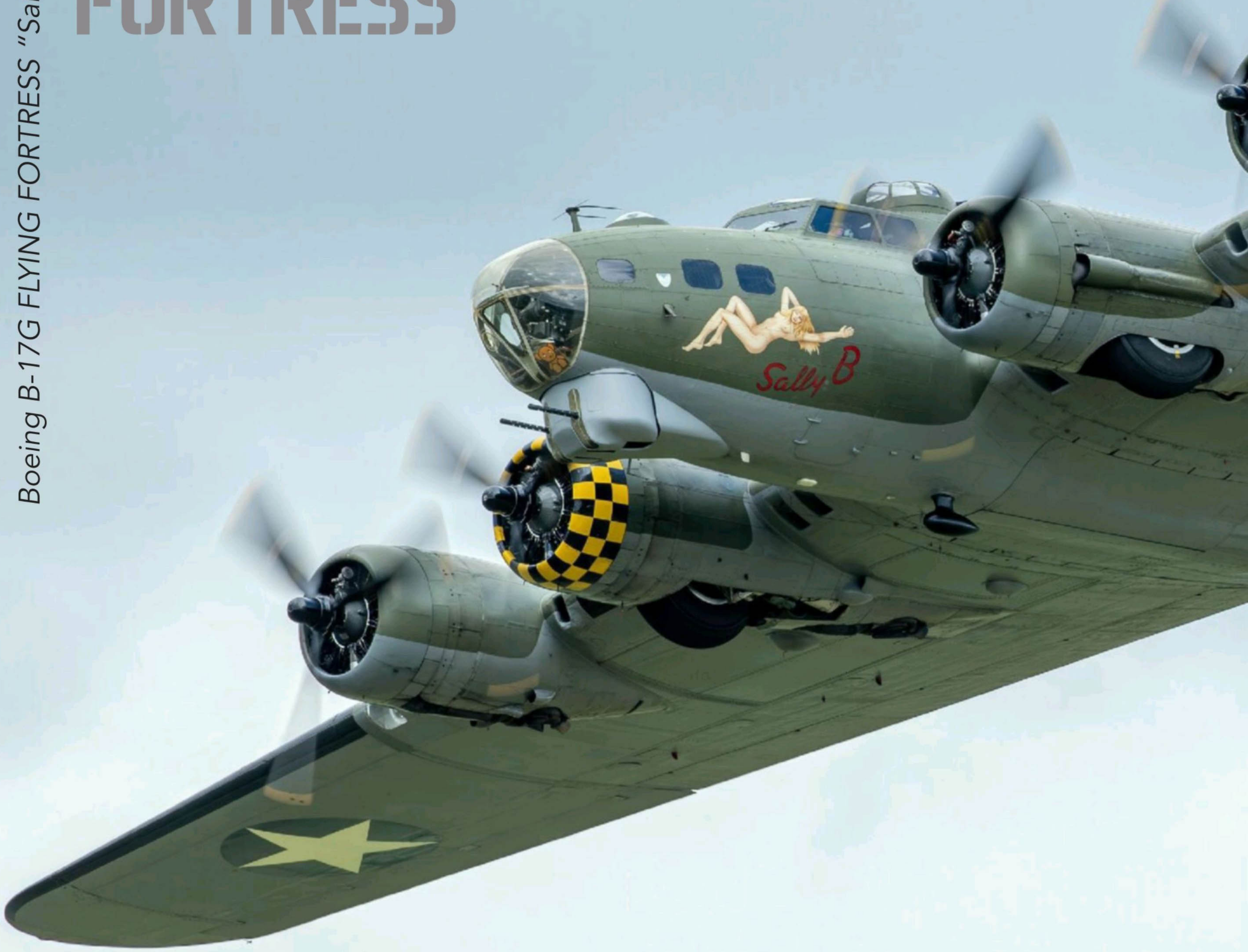
CRUZEX is back! Due to a variety of reasons, the biggest military exercise in South America had to be put on hold, but the Brazilian Air Force has come back to the world stage once again. With the modernization of the Brazilian Air Force and the introduction of new types, like the F-39E GRIPEN and the KC-390 MILLENIUM, the FAB is making big steps into the future. This makes it clear that they want to continue to develop their ways of working and expand on the knowledge sharing. Both between their own squadrons as well as allies in South America and beyond the continent. With the advantages of airspace and weather, CRUZEX is a good opportunity for nations to come together and build on experiences gained during their own operations. For aviation enthusiasts CRUZEX is a great exercise, providing types and air arms you don't often see.

Erik Bruijns / CHK6

B-17G FLYING FORTRESS

Sally B

Boeing B-17G FLYING FORTRESS "Sally B" / image by: Will Moore



The Boeing B-17 FLYING FORTRESS is probably the best known American four-engine bomber of the Second World War, although it was not the most produced aircraft of its type as that honour goes to the Consolidated B-24 LIBERATOR. With a standard payload of up to 6 000 pounds (2 722 kg) for long-range missions and a combat range of around 2 000 miles (3 200 km), the B-17G combined striking power with formidable defense, boasting thirteen .50 caliber (12.7 mm) machine guns. Its resilience and firepower made it a formidable adversary and a key contributor to the Allied victory over Nazi Germany. Shortly after the war ended, the majority of B-17 FLYING FORTRESSES were retired from service and scrapped, as the aircraft had already become technically obsolete. However, some found new roles - serving as testbeds for experimental engines and equipment, or being converted into firefighting aircraft. Of the 12 731 airframes produced between 1937 and 1945, only a few remain airworthy today. Among them, the sole flying example in Europe is the iconic B-17G "Sally B"

Story: Bob Barton

Images by: Will Moore & Robert Kysela

124485
A

Sally B
AIR LIVERY

Boeing B-17G FLYING FORTRESS "Sally B" / *image by: Robert Kysela*

Happy Anniversary "Sally B"

The year 2025 marks both the 50th anniversary of "Sally B" operations and her 80th birthday, a truly remarkable milestone but also one that raises the question: how does she continue to fly without the backing of a wealthy owner or major sponsor? The truth is that Sally B remains airworthy and flying on a budget of under £200 000 a year - an extraordinary achievement made possible through a blend of resourcefulness and dedication. This includes income from airshow appearances and media work, generous support from benefactors such as the Bomber Command Association and private legacies, and the tireless efforts of a volunteer team who maintain and operate the aircraft without pay. Additional support comes from sponsors, a large and loyal supporters' club, and numerous companies and individuals who provide goods and services either free or at greatly reduced cost. At the heart of it all is Elly Sallingboe, who oversees the entire operation as Operator and Chairman of Trustees.

In January we made our way to Hangar T2 North at IWM Duxford to meet Elly and B-17 Training Captain and fellow Trustee, Peter Kuypers. T2 North is where "Sally B" lives during the off season (sharing the space with her North American friend, the Consolidated PBY CATALINA, "Miss Pick Up") and we met in the shadow of "Sally B" herself, perched on jacks, with her cowlings removed and the starboard wing tank extracted for a corrosion inspection, surrounded by a team of dedicated engineers and technicians. The wooden floor had also been removed to allow inspection and cleaning of the lower fuselage - often referred to as the belly or "bottom boat." As a result, we were limited to taking photos from outside, as entry into the aircraft wasn't possible.

Chatting to Deputy Chief Engineer, Steve Carter, we discovered that not only is her floor constructed of wood, but so too are the ammunition boxes for her thirteen .50 caliber Browning machine guns, sections of the fuselage side panelling, and the benches used by the Radio Operator and Navigator. It was a practical decision by Boeing's designers due to wood being lightweight, strong, readily available, and inexpensive. Naturally, we arranged to return for interior photographs once the floor was reinstalled.

So how did Elly Sallingboe become involved? It all began in 1975, when her partner, Ted White, brought the B-17 from France's Institut Géographique National (IGN) to the UK. Formerly used for aerial survey work, the aircraft arrived at Biggin Hill on 15 March 1975. Ted named her "Sally B" as a tribute to Elly. Not long after her arrival, "Sally B" was relocated to her permanent home at Duxford.

Wright R-1820 Cyclone / *image by: Will Moore*

Maintenance / *image by: Will Moore*

Peter Kuypers / *image by: Will Moore*

The History of "Sally B"

For seven years, "Sally B" was a regular sight at airshows in the United Kingdom, captivating crowds wherever she flew. There was also a plan in progress for the Great Warbirds Airshow at West Malling in Kent. Tragically, disaster struck when Ted was killed flying his beloved North American AT-6D-NT HARVARD Mk.III after the 1982 Malta Air Rally. While most would have walked away, despite her grief, Elly pressed on, determined not only to carry out the show but also to keep "Sally B" flying as a tribute to Ted. As a lasting symbol of that tribute, Elly painted the inboard starboard engine cowling with black and yellow chequerboard marking, echoing those that were on Ted's HARVARD. The Great Warbirds Airshow went on to become one of the UK's most celebrated aviation events, until 1992, when Kent County Council closed the airfield to make way for residential and commercial development.

Built as a Boeing B-17G-105-VE c/n 8693, the future "Sally B" was one of the last to be constructed by the Lockheed-Vega plant at Burbank, California. Accepted by the United States Army Air Force (USAAF) as 44-85784 on 19 June, 1945, she was too late to see service in the war and was flown to Nashville for modifications. Converted for training purposes and re-designated TB-17G, special duty training version and engine testbed, company designation Model 299Z (two aircraft were modified from Lockheed-built B-17Gs and later redesignated JB-17G), she was based at Wright Field (now Wright-Patterson AFB), Ohio from November that year.

Continuing in the care of 2750th Air Base Group (ABG), '784 was selected for use as a research vehicle and in 1949 allocated EB-17G, status. As such she performed a variety of research roles, one of the most bizarre being the addition of a man-carrying pod on the starboard wingtip. Also fitted at the time was an infra-red tracking device in place of the Perspex nose. These trials continued for some years in a variety of guises and it was not until 1954 that '784 was returned to standard configuration, less armaments, at Hill AFB, Utah.

The aircraft arrived in France in November 1954 and was registered as F-BGSR. Based at Creil alongside other B-17s, she performed aerial survey work for the French government and various clients with steadfast reliability for many years. By the early 1970s, however, the rising costs of operating the Flying Fortresses along with increasing difficulties in sourcing spare parts made their continued use unsustainable. As a result, the IGN began replacing the B-17s with more modern aircraft, including the specially designed Hurel-Dubois HD.34.

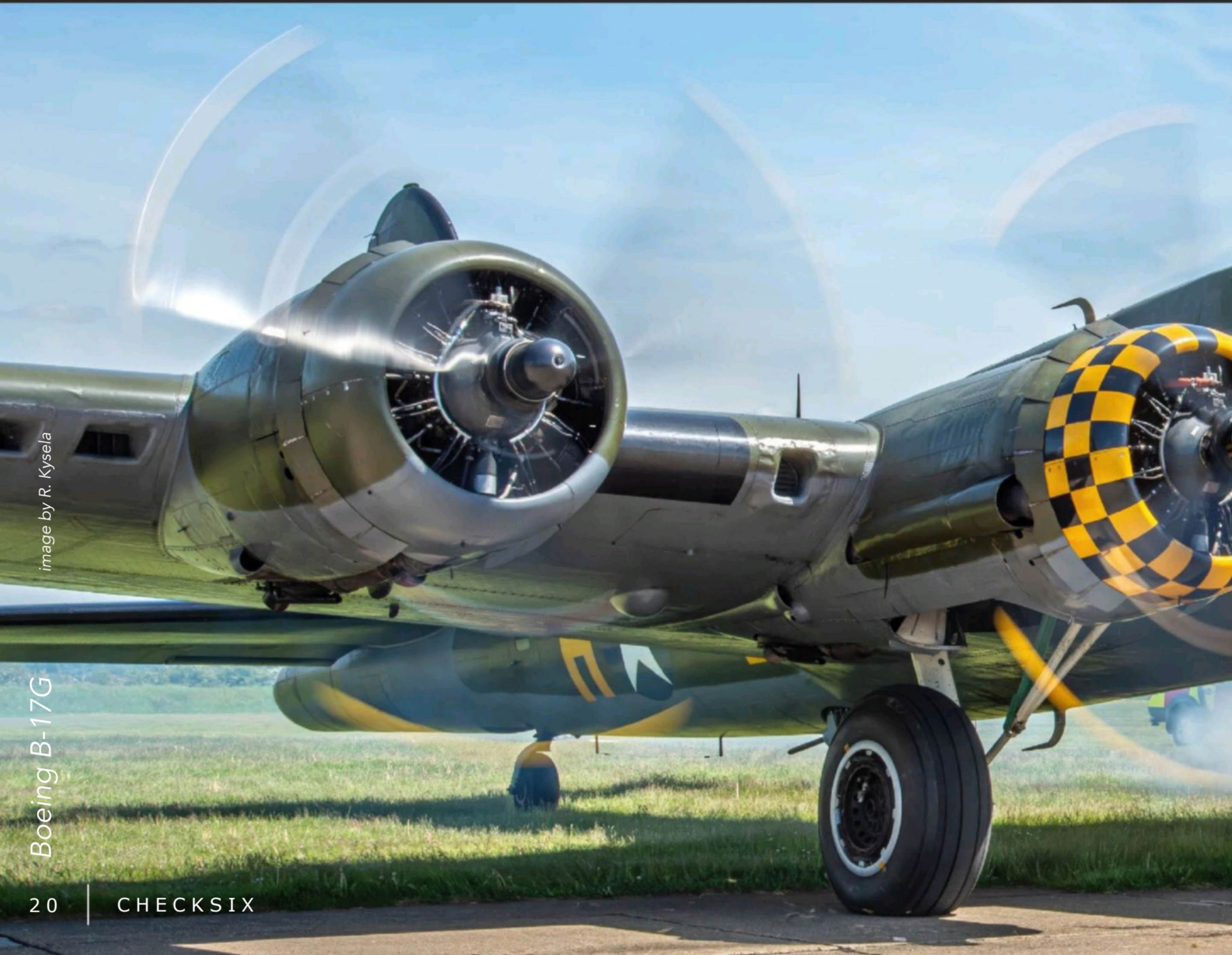


image by R. Kysela

Boeing B-17G

Boeing B-17G FLYING FORTRESS / image by: Robert Kysela

Memphis Belle
CHIEF ENGINEER PETER BROWN

Techn. Specs: Boeing B-17G FLYING FORTRESS

Length:	74 ft 4 in (22,66 m)
Height:	19 ft 1 in (5,82 m)
Wingspan:	103 ft 9 in (31,62 m)
Take-off weight:	65 500 lbs (29 700 kg)
Vmax.:	287 mph (462 km/h)
Rate of climb:	900 ft/min (4,6 m/s)
Range:	1738 nm (3 219 km)
Powerplant:	4 x Wright R-1820-97 Cyclone
Performance:	895 kW (1 200 PS)
Armament:	13 x .50 in Browning M2
Bombload	8 000 lbs (3 600 kg) on short range missions

Boeing B-17G FLYING FORTRESS "Sally B" / *image by: Robert Kysela*

SINCE 1916
BOEING
SEATTLE, USA

CHIEF ENGINEER PETER BROWN

Dorsal turret / image by: Robert Kysela

The ultimate Flying Fortress

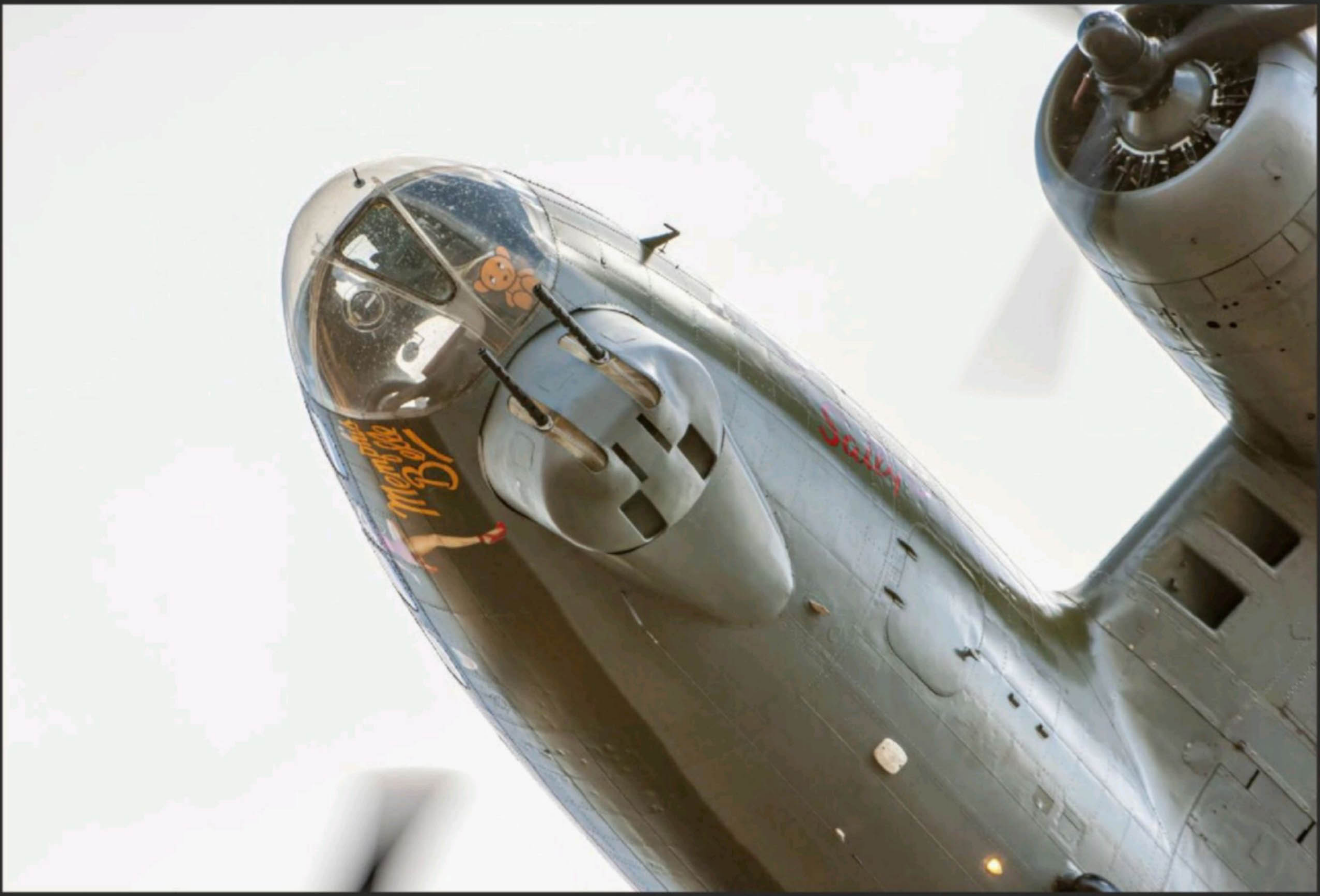
Most aviation enthusiasts are well aware of the pivotal role the B-17 played in World War II. It served as the backbone of the Mighty Eighth Air Force's daylight bombing campaign against the Third Reich. Despite its relatively modest bomb load, B-17s dropped more bombs than any other aircraft. Remarkably, it was responsible for 42.6% of all bombs dropped on Germany and its occupied territories, amounting to an astonishing 1.28 billion pounds of bombs (over 580 000 000 kg).

Given that 12 731 B-17s were built, second in number only to the B-24 Liberator, with 18 188 produced, it is remarkable that only 46 examples survive today. Following two recent losses, only four B-17s remain airworthy, with "Sally B" being the sole example currently flying outside the United States. While Liberators did see service in Europe, they were primarily deployed in the Pacific Theatre, where their superior range and endurance proved especially valuable.

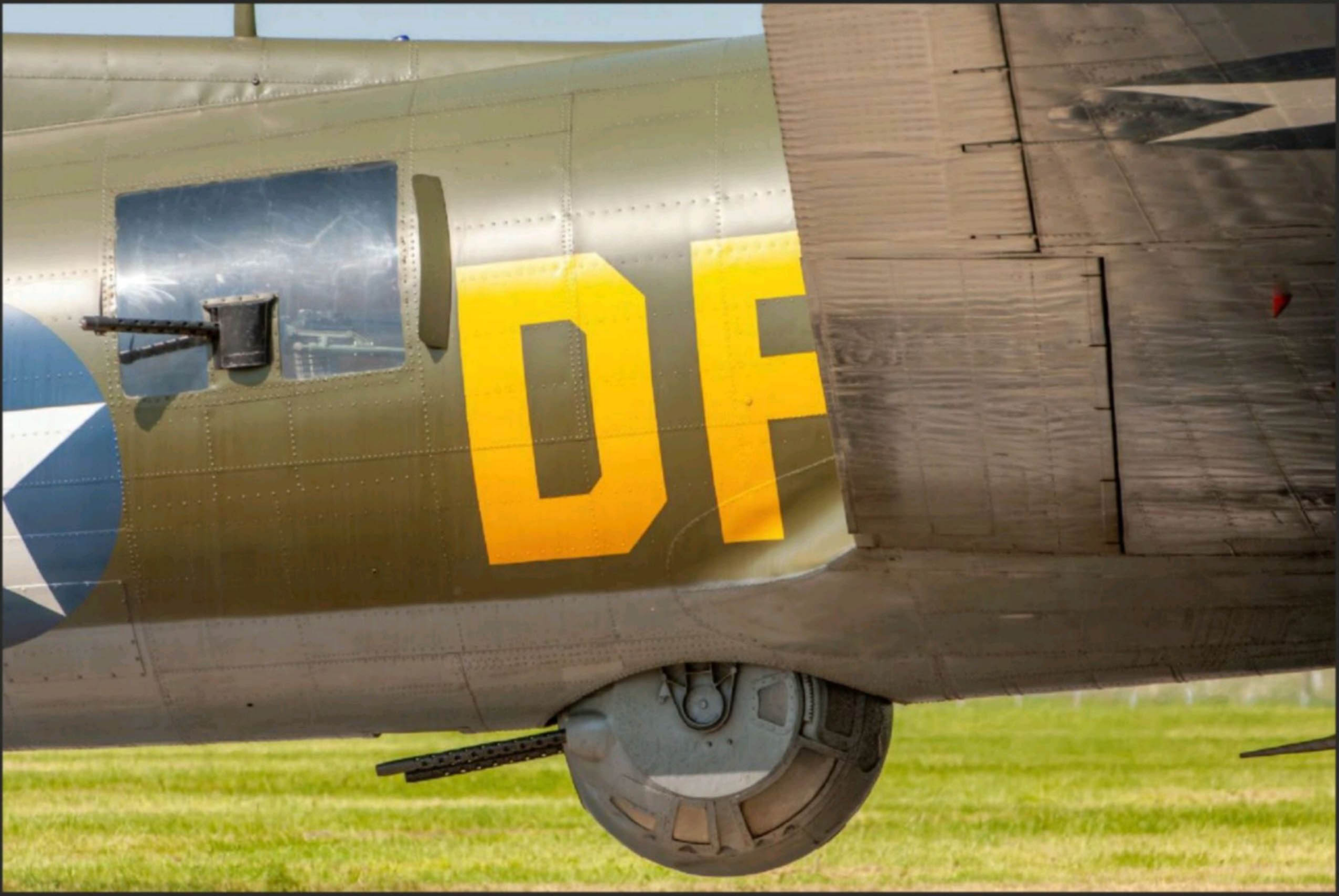
Assigned to the most heavily defended regions of Germany, B-17s faced staggering odds - crews had only a 25% to 33% chance of completing the required 25 missions to finish a combat tour. Even more sobering is the fact that the average age of those young airmen was just 24 or younger.

B-17s served in every theatre of World War II and took on a range of roles beyond that of heavy bomber, including submarine hunting with the Coastal Command of the RAF and use as executive transports. However, the B-17 was primarily the backbone of the USAAF strategic bombing campaign in the European theatre. Earlier variants from A to F were produced in relatively small numbers, gradually refined until the arrival of the definitive G model, easily recognized by its distinctive nose-mounted chin turret. Today, "Sally B" serves as a powerful and moving airborne memorial to the 4 735 B-17s lost in combat and the 47 483 young crew members who gave their lives. She also stands in tribute to the thousands more who were wounded, taken prisoner, or left forever marked by the war.

The definitive version of the B-17, the G model, entered service in the summer of 1943. Bristling with firepower, it was equipped with no fewer than thirteen .50-caliber machine guns, including the newly added "chin" turret designed to counter deadly head-on fighter attacks. In addition to the twin chin guns, the B-17G featured twin guns in the dorsal and tail turrets, single forward-firing "cheek" guns on either side of the nose, two staggered beam guns for side defense, and an upward-firing gun positioned behind the radio operator's station. Operated by a crew of ten that included a pilot, copilot, navigator, radioman, bombardier, and multiple gunners, the B-17G had a service ceiling ranging from 25 000 to 35 000 feet (7 500 to 10 500 meters), enabling it to fly high above enemy territory on its long-range bombing missions.


Memphis Belle
Sally

Remotely controlled chin turret / image by: Robert Kysela



Ball turret & Waist gunners position / image by: Robert Kysela

Boeing B-17G "Sally B" Cockpit / Image by: Robert Kysela

B-17G / P-51B / P-47 / *image by: Robert Kysela*

B-17G "Sally B" / *image by: Robert Kysela*

B-17G "Sally B" with open bomb bays / *image by: Robert Kysela*

Operations

The USAAF's policy of daylight precision bombing, which was markedly different from the RAF's strategy of night raids, initially proved far more costly than anticipated. The main issue was the lack of long-range escort fighters capable of accompanying bombers deep into enemy territory. This vulnerability reached a critical point during the infamous raids on the Regensburg and Schweinfurt ball-bearing factories, where each mission resulted in the loss of around 60 bombers, roughly 20% of the attacking force, an unsustainable attrition rate. These heavy losses prompted a pause and strategic reassessment. Relief came with the introduction of the North American P-51 MUSTANG, and to a degree the Republic P-47 THUNDERBOLT, both of which, when fitted with drop tanks, could escort the bombers all the way to their targets and back, dramatically improving survivability.

The USAAF placed great faith in the Norden bombsight, an advanced analogue device they famously claimed could "drop a bomb into a pickle barrel from 30 000 feet." In reality, accuracy fell short of such boasts, as hits within 100 feet of the target still required a degree of luck and ideal conditions. Even so, the Norden bombsight offered greater precision than what the RAF typically achieved during their night bombing campaigns.

It's interesting to note that the Boeing B-17 very nearly missed out on selection by the USAAF. During the competition for a new heavy bomber, the prototype crashed and was technically disqualified. However, Boeing's privately funded prototype, powered by Pratt & Whitney Hornet engines, had impressed evaluators so much that a path was found to bring a version powered by Wright Cyclone engines into service. Ironically, the crash was caused by something as simple and preventable as failing to remove a control lock before takeoff. This incident directly led to the introduction of what is now a standard practice across aviation: the pre-flight checklist.

The aircraft is a truly fitting tribute to the young Allied airmen who fought and fell in the skies over Europe in the name of freedom. But how does one keep this 80-year-old, complex, four-engined bomber airworthy for the 6 000 flying hours she has now logged? The answer lies in meticulous care and respectful handling. Today, she is flown gently, far removed from the spirited manoeuvres of her early airshow days. During the winter months, she's safely sheltered in a hangar, though during the airshow season from May to September, she must remain outside, sometimes in less than ideal conditions owing to the UK's damp climate.

image by: Stuart Tamblin

Peter Kuypers & Elly Sallingboe

Operating the "Sally B":

To cover the immense costs of keeping "Sally B" airworthy, Elly Sallingboe and her dedicated team work tirelessly year-round to raise funds. Meanwhile, Peter Kuypers plays a vital role in sourcing rare and hard-to-find spare parts. With the help of a friend in the United States who collects and ships his purchases annually, Peter manages to track down many components simply by searching part numbers online. One of his recent successes was acquiring a batch of Boeing B-29 wheels, which are fully compatible with the B-17, and feature aluminium split rims that make tyre changes far easier than with the original single-piece alloy wheels. As mentioned earlier, maintaining "Sally B" requires nearly £200 000 each year. The largest single cost is insurance: £100 million in public liability cover is mandated, even though she only flies around 20 hours annually. Fuel is another major expense as the engines need approximately 200 gallons (800 litres) of fuel and 10 gallons (40 litres) of oil per hour. For every hour in the air, around 10 hours of ground maintenance are required, all of which is handled by a loyal team of volunteers led by Chief Engineer Daryl Taplin.

Boeing B-17G FLYING FORTRESS "Sally B" / image by: Robert Kysela

An interesting detail concerns her propellers: "Sally B" requires five in total, four on the aircraft and one spare. Each propeller must be serviced every five years, meaning one undergoes overhaul annually. Coincidentally, she uses the same type of propeller as the Douglas DC-3/C-47 DAKOTA, which helps with compatibility and availability. Every five years, a major structural inspection is also required. The wing roots must be uncovered to conduct what's known as a main spar inspection. This involves non-destructive testing (NDT) of the main spar attachment bolts, along with a thorough corrosion check - an inspection mandated by the U.S. Federal Aviation Administration (FAA).
In addition to the dedication of her volunteer crew, "Sally B" is supported by a number of generous companies who provide equipment and services, often at reduced rates, or even free of charge, playing a crucial role in keeping this historic aircraft flying.

Memphis Belle

When you look at photos of the B-17G "Sally B," you'll quickly notice that the nose art on the starboard side differs from the artwork on the port side. Instead of a reclining, undressed beauty, you see a very graceful woman, dressed in a red corsage and high heels. The figure's face is left to the imagination, as she is depicted from behind at an angle, accompanied by the lettering "Memphis Belle" beneath the artwork. The original aircraft bearing this name is likely the most famous B-17 of the USAAF, as it was the first to complete the required 25-mission tour over Germany. Unlike many other warring nations, the United States imposed strict mission requirements for its aircrews. In the early years of the war, bomber crew losses were alarmingly high, especially during the initial phase of American bombing operations, when tactics and defenses were still being developed. In 1943, the odds of surviving 25 missions were less than 30%.

The original aircraft was a B-17F-10-BO with serial number 41-24485, built in 1942 and stationed at RAF Bassingbourn from November 1942 until its last mission on 17 May 1943, where it was part of the 324th Bomb Squadron / 91st Bomb Group. The bomber crew was commanded by Captain Robert Knight Morgan. He also came up with the name "Memphis Belle," inspired by Margaret Polk, a 19-year-old student from Memphis, Tennessee, who was his girlfriend at the time. Captain Morgan named his B-17 in her honour.

So what does "Sally B" have to do with "Memphis Belle"? Well, she played the starring role in the 1990 Hollywood film *Memphis Belle*, a dramatization of the 1944 documentary *The Memphis Belle: A Story of a Flying Fortress*. This film was produced during active missions with the USAAF at RAF Bassingbourn near Cambridge. One of the cinematographers on the film, J. Tannenbaum, a veteran of WWI, was killed during filming when his aircraft was shot down. The story

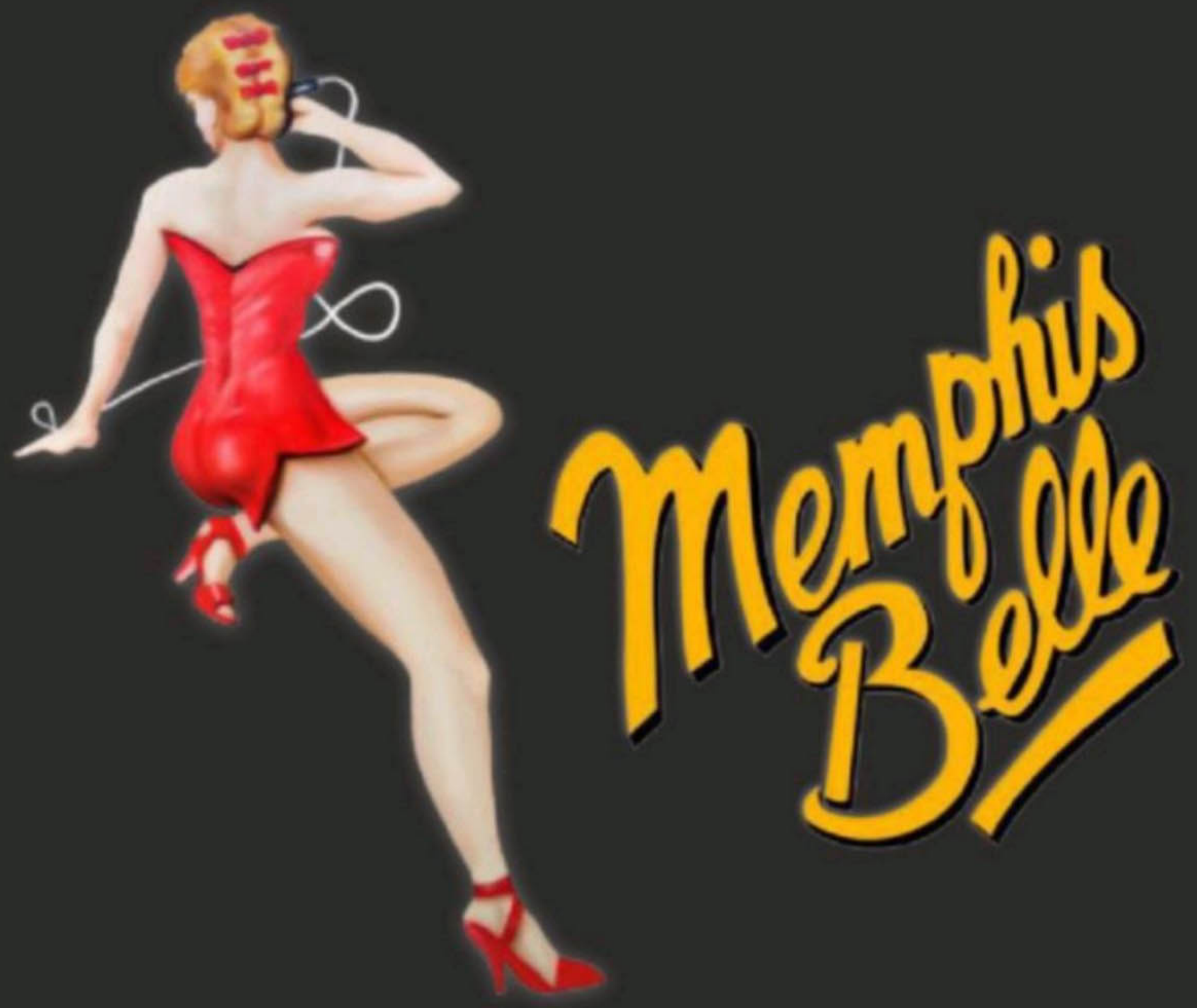
Boeing B-17G "Sally B" / image by: Robert Kysela focused on the Boeing B-17F “Memphis Belle” as her crew reached their 25th and final mission, the milestone that qualified them to return home to the United States. This landmark mission took place on May 17, 1943, when the Boeing B-17F bomber and its crew flew a dangerous mission over Bremen, Germany, targeting the Focke Wulf aircraft plant.

For the remake released in 1990, producers David Puttnam and Catherine Wyler (daughter of the original films Director William Wyler) with director Micheal Caton-Jones assembled five airworthy Boeing B-17 bombers. Two of these aircraft, the B-17G N3703G and the Boeing B-17F N17W were flown from the US to the Imperial War Museum (IMW) site at Duxford Cambridgeshire. Two came from France (Boeing B-17G F-BEEA and B-17G F-AZDX) and finally the Boeing B-17G “Sally B“ already based at IWM Duxford. Unfortunately, one of the French B-17s (F-BEEA) was lost in a take-off accident during the project at RAF Binbrook, all ten of the crew escaped, but the aircraft was a write off. The Chief Engineer of “Sally B“, Peter Brown, was asked to be the Aeronautical Consultant by the co-producer Eric Rattray, tasked with ensuring that all the aircraft were serviceable during shooting.

Memphis Belle

The actual "Memphis Belle" was a Boeing B-17F, so for accuracy, all the B-17G models used in filming had to undergo modifications. This included the removal of the chin turret and alterations to the tail gunner position to match the older B-17F configuration. The aircraft were also painted in the olive drab war time scheme. Two aircraft were used to represent the "Memphis Belle" during filming: one was N3703G, and the other was "Sally B." The latter was the only aircraft equipped with pyrotechnics and ammunition to simulate engine fires and machine gun firing from the ball and tail gunner positions. Additionally, "Sally B," along with the others, was given various nose arts and other details to represent multiple B-17s during filming, creating the illusion of a full squadron of bombers. For the film's climax, a tense "will they or won't they make it back" scene, "Sally B" had its tail section replaced to depict the severe battle damage sustained during the final mission. Although the film meant an extensive workload for the “Sally B“ team, it also generated a much needed injection of funds that ensured the immediate survival of the aircraft. Ultimately the outcome of all the extra work was very satisfying for the team and brought the aircraft and IWM Duxford to a new audience at home and overseas. “Sally B“ has retained the war time paint scheme and also carries duel noise art with the “Sally B“ art on the port side and “Memphis Belle“ on the starboard side of the nose section.

After completing its 25th mission, "Memphis Belle" returned to the U.S. and was used extensively to support war bond drives. It became a powerful symbol of hope, determination, and the courage of the crews who undertook perilous missions during the war. Today, the aircraft is proudly displayed at the National Museum of the United States Air Force at Wright-Patterson Air Force Base in Dayton, Ohio, having undergone an extensive restoration.



Verdict:

Boeing B-17G FLYING FORTRESS “Sally B” remains a living, flying tribute to the thousands of young airmen who served, and too often perished aboard the famous bomber during World War II. Thanks to the tireless efforts of Elly Sallingboe and her dedicated team of volunteers, this iconic aircraft has not only survived but has flown for over 6 000 hours, continuing to inspire and educate new generations. Keeping her in the air is no small feat, with soaring costs, strict maintenance requirements, and the constant search for rare parts. Yet through a combination of public support, volunteer labour, generous sponsors, and sheer determination, “Sally B” continues to fly against the odds. What about the future? That question remains open-ended, as Elly and her team make the decision each year whether to carry on. For the past 50 years, the answer has always been a hopeful and resolute “Yes, one more year!” and all who cherish “Sally B” can only hope that tradition continues. While nothing is guaranteed, the aircraft’s survival to date has already been nothing short of remarkable. A true testament to passion, perseverance, and respect for history. Long may she fly.

Bob Barton / CHK6 UK

Boeing B-17G “Sally B” / image by: Robert Kysela

PETER BROWN
Memphis Belle

To find out more about “Sally B” do visit her web site: **https://www.sallyb.org.uk**

Or to become a supporter see: **https://www.sallyb.org.uk/supporters-club.htm**

SUKHOI SU-22 “FITTER”

in Polish service

Sukhoi Su-22M4 - NATO Code: FITTER-K / *image by: Robert Kysela*

Another chapter in military aviation history is coming to an end—this time, it’s the Polish Sukhoi Su-22M4/UM3K that is nearing retirement. Poland remains the last country to operate this legendary Cold War-era fighter-bomber in active service. While the end of flight operations has been announced multiple times in the past, it now appears that the clock is finally running out for the FITTER.

Although no official retirement date has been confirmed, it is widely expected that by early autumn of this year, a Polish FITTER pilot will ignite the afterburner of the Lyulka AL-21F-3 engine for the final time and thunder down the runway. Currently, all remaining Polish Su-22s are stationed at the 12th Air Base in Mirosławiec. Their original home base in Świdwin is undergoing modernization to accommodate the future deployment of the Lockheed Martin F-35A LIGHTNING II.

story & images by: Robert Kysela

Sukhoi Su-7 / NATO Code: FITTER

Performance pays off, even the former Soviet Union couldn't entirely escape this universal truth, at least not in the realm of its aviation industry. Outstanding and successful aircraft designers were often rewarded with the establishment of their own design bureaus, named in their honor. Such was the case for the young and ambitious chief designer at the Tupolev Design Bureau (OKB – Opytno Konstrooktorskoye Byuro, meaning "Experimental Design Bureau"): Pavel Osipovich Sukhoi.

Following the successful design of a light, single-engine bomber designated ANT-51, originally developed for the Tupolev OKB, the aircraft entered serial production in 1940 under its new name: Sukhoi Su-2. With this, the foundation was laid: Sukhoi was entrusted with his own design bureau.

Such a design bureau, however, was not a production facility in the traditional sense. At best, mock-ups and prototypes could be built there; full-scale serial production was always carried out by specialized industrial plants.

After World War II, the Sukhoi OKB developed a series of experimental aircraft, all powered by jet engines. These innovative designs solidified the bureau's reputation as one of the leading forces within the Soviet aviation industry.

By the early 1950s, the Soviet tactical air forces were under increasing pressure to field modern combat aircraft capable of keeping pace with Western developments, particularly American models such as the North American F-100 SUPER SABRE, the McDonnell Douglas F-101 VOODOO, and the Lockheed F-104 STARFIGHTER. In response to these

image by: Robert Kysela

Sukhoi Su-7UM - NATO Code: FITTER-B

demands, the Sukhoi Design Bureau began developing a new single-engine combat aircraft, envisioned in two distinct variants: a tactical fighter-bomber and an all-weather interceptor. To accommodate the differing mission profiles, the design featured two separate wing configurations, one with sharply swept wings (60° sweep at the leading edge, 55° at the trailing edge), and an alternative delta wing version.

At that time, there was still uncertainty about which wing configuration would best meet operational requirements. The prototype of the tactical fighter with swept wings was designated S-1, the "S" stood for Strelovidnoje Krylo, meaning "swept wing." The aircraft was powered by the AL-7F engine from the Lyulka Design Bureau. The "F" indicated the inclusion of an afterburner, which enabled the engine to produce 7 500 kp of thrust in dry power and up to 10 000 kp in afterburner mode.

One particularly notable feature was the planned armament: three NR-30 autocannons (named after designers Nudelman and Richter), mounted in the wing roots. Due to the odd number of guns, an asymmetrical layout was chosen, one cannon in the left wing, two in the right, each with a 65-round ammunition load. The S-1 made its maiden flight on September 7, 1955, and subsequently entered an intensive test program. The insights gained from this program informed the development of a second prototype, designated S-2. The S-2 featured several design refinements, including an 11-centimeter extension of the forward fuselage and a further 40-centimeter stretch of the center fuselage section, which housed an additional fuel tank. To compensate for the added weight, the third NR-30 cannon was omitted.

Neither the S-1 nor the S-2 was equipped with an interceptor radar. Instead, they featured only a basic rangefinder, the SRD-4 "Grad", used to assist in aiming the onboard cannons. The avionics suite was complemented by what was considered a modern navigation system at the time, consisting of the ARK-5 direction finder, the GIK-1 gyroscopic compass, and the MRP-48P radio beacon receiver. This equipment allowed the pilot to reliably reach targets even during night missions or under poor weather conditions. For self-protection, the aircraft was fitted with the rearward-facing Sirena-2 radar warning receiver, designed to alert the pilot to approaching enemy aircraft from behind. An IFF transponder (Identification Friend or Foe) was also installed to help prevent friendly fire incidents by ground-based air defenses. The pilot sat in a fully pressurized cockpit, a vital feature for high-speed, high-altitude operations, and was equipped with an ejection seat developed by Sukhoi

After the loss of the first prototype in a landing accident, which tragically claimed the life of test pilot Igor Sokolov, the revised S-2 was chosen as the basis for serial production of the new Soviet tactical fighter. This aircraft was officially designated the Su-7. Notably, the number "7" in the type designation does not, as was customary, indicate a sequential number within the Sukhoi aircraft series. Instead, it refers to the AL-7F engine type used in the aircraft. The prototype was publicly unveiled for the first time at an airshow in Tushino.

Delivery of the first production models began in May 1958. By the time production ended in 1972, a total of 1 847 units had been built. Besides the Soviet Union, the Su-7 was operated by several Warsaw Pact countries and numerous Soviet allies. For example, the Egyptian Air Force operated 185 of these aircraft. The West first took notice of the new fighter at the Tushino airshow in 1960. India was the second-largest operator with 140 Su-7s, which by that time had been assigned the NATO reporting name "FITTER."

Evolution - from Su-7 to Su-22

The Sukhoi Su-7, NATO codename FITTER-A/B, was the Soviet armed forces' first supersonic fighter-bomber. Produced in large numbers, it was not only operated by the Soviet Air Force but also exported to allied and friendly states. Within the Warsaw Pact, Poland was the largest user of the Su-7 after the USSR, with 47 aircraft. The Polish Air Force operated 40 Su-7BM models as well as seven two-seat trainer versions, the Su-7UM.

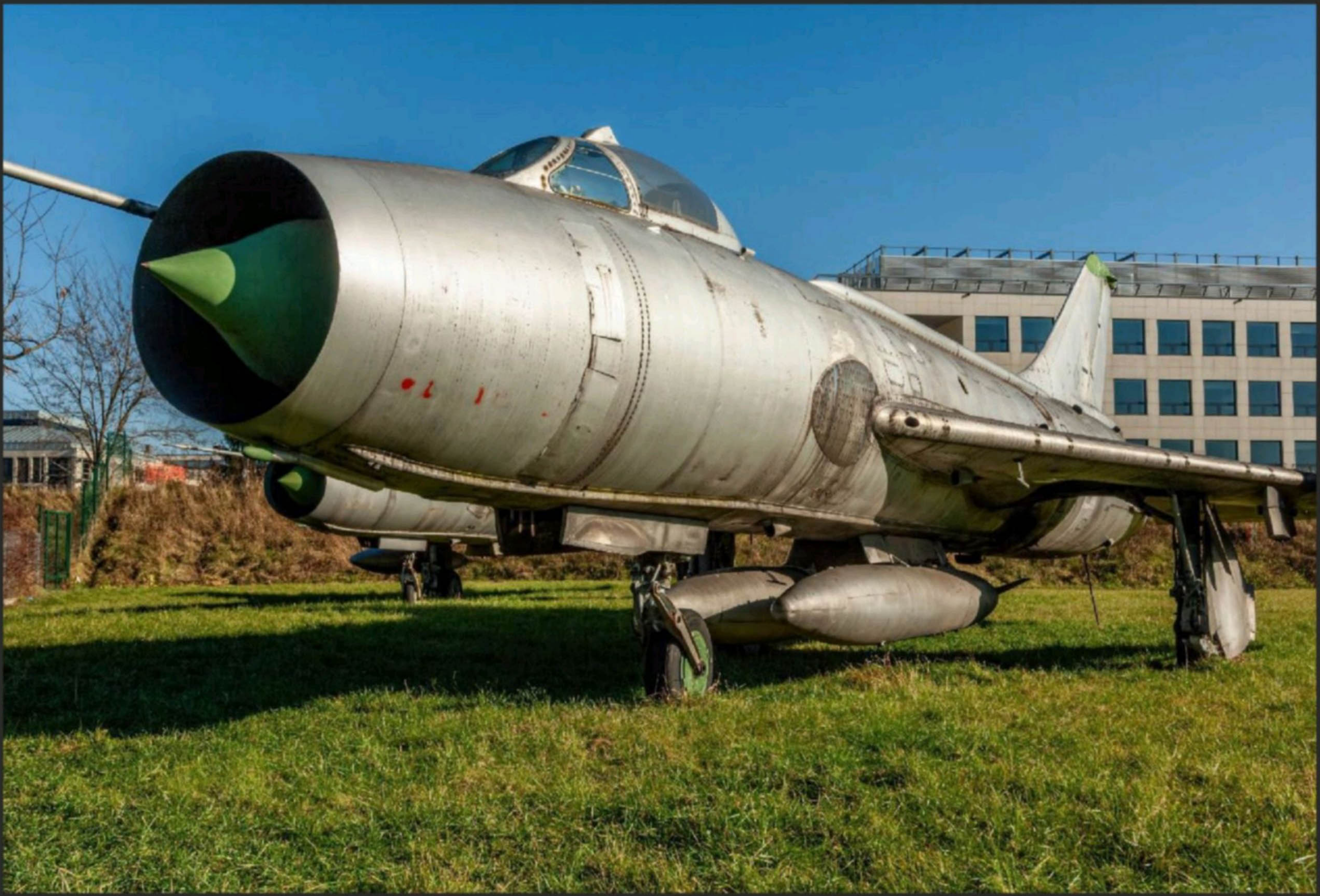
The Su-7 was known for its remarkable robustness but also had several drawbacks that posed challenges not only from a pilot's perspective but also limited its combat effectiveness. These included:

- Very high takeoff and landing speeds
- High fuel consumption
- Short operational range
- Poor pilot visibility
- Challenging flight characteristics
- Basic avionics
- No defense systems against guided missiles
- Lack of precision in weapons delivery

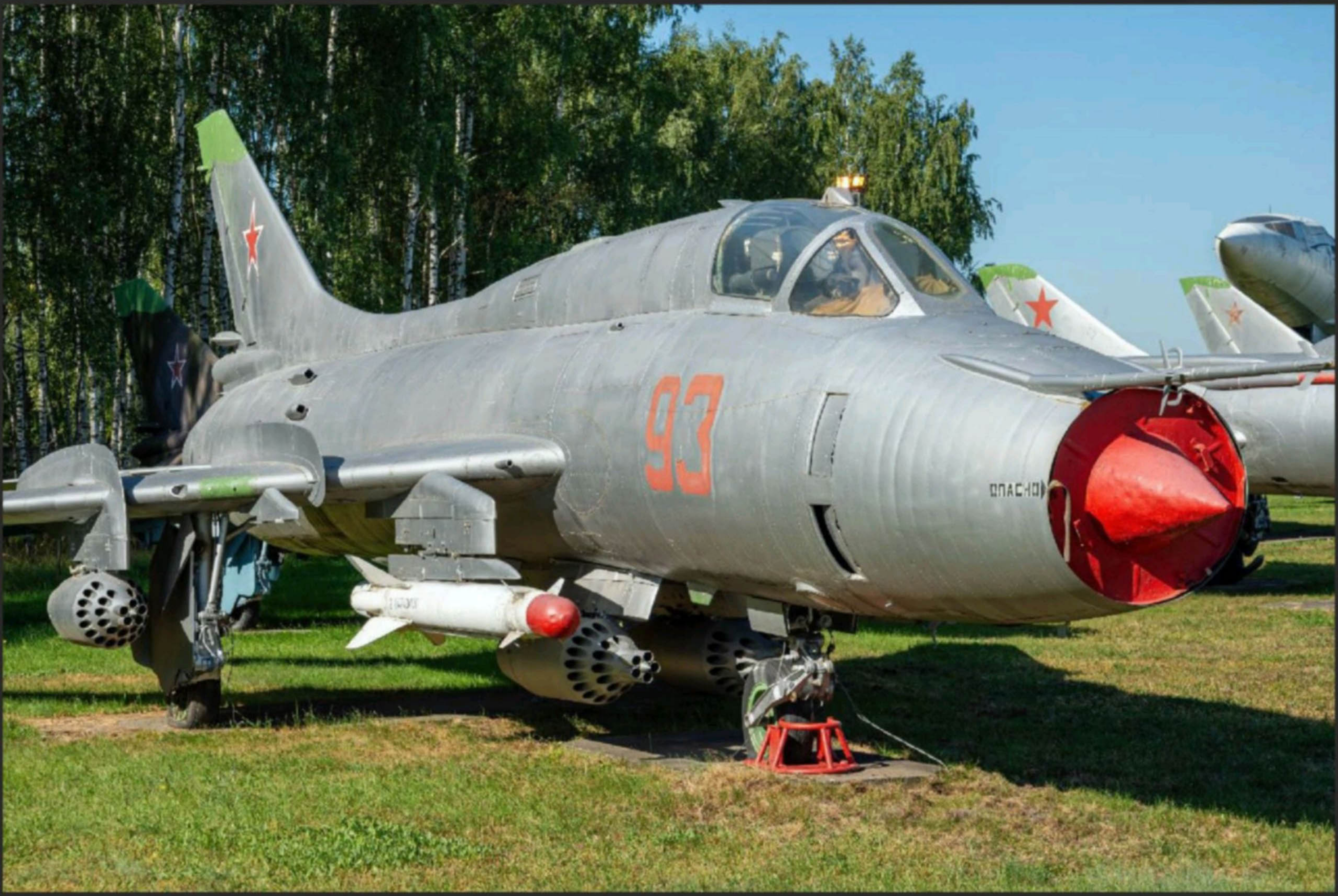
The mindset of military leaders and aircraft designers at the time was strongly driven by one goal: speed. The underlying belief was essentially this: whoever possesses the fastest combat aircraft wins the war. In the air battles of World War II, speed indeed played a decisive role, alongside climb rate, range, and, to a somewhat lesser extent, the maneuverability of fighter planes. When the first jet-powered aircraft appeared, their superior speed rendered the previous piston-engine fighters obsolete virtually overnight. This technological leap shocked military leadership. Against this backdrop, it is hardly surprising that further development focused almost exclusively on one aspect: maximum speed.

According to the doctrine of the time, the primary task of fighter aircraft was to intercept and engage high-flying bomber formations at an early stage. Fighter-bombers, however, had a different role: their main mission was to attack enemy ground troops and positions. During combat missions, high speed was often a disadvantage because it left pilots very little time for target acquisition and tracking.

The first generation of FITTERs was equipped solely with free-fall bombs, unguided rockets, and cannons. They lacked both adequate target acquisition systems and good cockpit visibility, both factors that limited their effectiveness in combat.



Sukhoi Su-7BM (NATO Code: FITTER-A) - Muzeum Lotnictwa Polskiego w Krakowie */ image by: Robert Kysela*



Sukhoi Su-17M3 (NATO Code: FITTER-H) - Central Museum of the Air Force of the Russian Federation / image by: R. Kysela

For this reason, the Su-7 was also intended for the deployment of tactical nuclear weapons. In this role, high targeting accuracy was of secondary importance; what mattered most was the aircraft's high speed, which allowed the crew to escape the blast wave of their own detonation. Special attack profiles and operational procedures were developed for this purpose. Due to the aforementioned shortcomings, Sukhoi began revising the Su-7 series relatively early. One of the biggest drawbacks was the highly swept wings. While advantageous for transonic and supersonic flight, they required a high minimum speed and limited maneuverability. They also contributed to the aircraft's high landing speed. The solution was to develop a variable-geometry wing aircraft. This innovation significantly reduced many of the weaknesses and greatly improved the overall flight characteristics of the FITTER. In the case of the Su-7, not the entire wing was made swingable, but only the outer portion, about half of the wingspan. This approach substantially reduced design complexity, since neither the fuselage nor the landing gear required fundamental changes. At the same time, it ensured that the aircraft's center of gravity shifted only minimally when the wings were swept.

The first prototype, designated S-22I, made its maiden flight on August 2, 1966. It quickly became evident that the new design significantly improved flight characteristics. For example, the landing speed was reduced by up to 60 km/h compared to the Su-7B. After a brief testing period, it was decided to switch serial production to the new generation of FITTERs featuring variable-geometry wings. Both versions were produced in parallel for three years, but from 1972 onward only the swing-wing variant was manufactured. This generational change was also reflected in the new designations: Su-17 for the Soviet Air Force and Su-20 for export models. NATO assigned the new variant the codename FITTER-C.

The next significant development step for the FITTER was the introduction of a new, more powerful engine: the Lyulka AL-21F. This modern engine was partly based on insights gained by Soviet engineers from analyzing a captured General Electric J79. Compared to the previous AL-7F, the AL-21F was more compact, efficient, and powerful. Its installation also allowed for a more aerodynamically optimized fuselage design. The version equipped with the new engine was designated Su-17M. The next iteration followed with the Su-17M2, which featured extensive modernizations to the avionics and weapons systems. These improvements significantly expanded the aircraft's operational capabilities. With these upgrades, the FITTER evolved from a traditional fighter-bomber into a true multirole combat aircraft.

The export version of this series was designated Su-22M and was assigned the NATO codename FITTER-F.

Sukhoi Su-22M4 (NATO Code: FITTER-K)

The next logical evolution of the FITTER series was designated Su-17M3 - NATO reporting name: FITTER-H. The most significant upgrade was the integration of a Doppler radar housed in the aircraft's nose cone, greatly enhancing both target acquisition and navigation capabilities. In addition, the aircraft received a larger vertical stabilizer and a removable ventral fin to improve directional stability. The original ejection seat was replaced with the K-36M, developed by the Zvezda Design Bureau, providing improved pilot safety. The avionics suite was extensively modernized. Key upgrades included a Klen-P laser rangefinder, a new analog navigation computer (KN-23-1), an improved autopilot system (SAU-22M1), and a more advanced radar altimeter (RV-15/A-031). The fuel capacity was also increased, thanks to the expanded dorsal fuselage section. For the first time in the FITTER family, the Su-17M3 was capable of carrying air-to-air missiles, significantly boosting its self-defense capabilities. In the export variant, designated Su-22M3, a different powerplant was used. Instead of the Lyulka AL-21F-3, the aircraft was equipped with the Tumansky R-29 engine.

The final and most capable version of the FITTER series was the Su-17M4 / Su-22M4. This variant marked a major technological leap with the introduction of the PrNK-54 digital weapons computer, used here for the first time. In combination with the Klyon-54 laser targeting system, the Su-17/22M4 gained the ability to employ precision-guided munitions, such as the Kh-25ML and Kh-29L laser-guided air-to-surface missiles. A new navigation computer (KN-23M) provided greater accuracy during target approach and attack runs. The cockpit layout was significantly improved, incorporating multi-function displays and a modern head-up display (HUD), which enhanced situational awareness and pilot ergonomics. A major advancement was the integration of enhanced self-protection systems. The M4 variant could be equipped with the SPS-141MWG ECM pod, designed to jam enemy radar and air defense systems. This electronic countermeasures pod featured multiple jamming and deception modes tailored to counter various radar types, particularly ground-based air defense systems such as the U.S.-made MIM-23 HAWK developed by Raytheon. When combined with the SPP-156 chaff and flare dispenser and the SPO-15LE "SIRENA 3" radar warning receiver, the survivability of pilots was significantly improved compared to all previous FITTER variants.

Sukhoi Su-22M4 NATO Code: FITTER-K / image by: Robert Kysela

Techn. Specs: Sukhoi Su-22M4 - NATO Code: FITTER-K

Length:	62 ft 5 in (19,02 m)
Height:	16 ft 1 in (5,13 m)
Wingspan:	44 ft 11 in (13,68 m)
Take-off weight:	42 990 lbs (19 500 kg)
Vmax.:	1 180 mph (1 900 km/h) Mach 1,7
Rate of climb:	13 800 ft/min (230 m/s)
Range:	1 585 nm (2 550 km)
Powerplant:	1 x Lyulka AL-21F-3
Performance:	110 kN(24 730 lbf) in afterburner mode
Armament:	2 x 30 mm NR-30 with 80 rounds 4 000 kg (8 818 lbs) on 10 pylons

Iljushin IL-10 & Tupoev Tu-4 / image by: Robert Kysela

PZL SBLim-2 (MiG 15UTI) - NATO Code: FAGOT / image by: R. Kysela

Sukhoi Su-20R - NATO Code: FITTER-C / image by: Robert Kysela

Polish Air Force - Siły Powietrzne

After World War II, Poland quickly began rebuilding its air force. The initial equipment of the Wojska Lotnicze Ludowego Wojska Polskiego (Air Force of the Polish People's Army) naturally came from Soviet stockpiles. These aircraft, primarily Yakovlev Yak-9s, Ilyushin Il-10s, and Tupolev Tu-4 bombers, soon became outdated and were replaced by more modern types such as the Mikoyan-Gurevich MiG-15 (NATO code: FAGOT) and the MiG-17 (NATO code: FRESCO). Some of these newer models were produced under license by Poland's own aviation industry. However, due to the rapid pace of technological advancement during this period, even these first-generation jet fighters became obsolete within just a few years and were replaced by more advanced aircraft. The only exception was the MiG-17, designated LIM-6 in Polish service, which continued to serve for a longer period in the fighter-bomber role. Ground-attack aircraft and fighter-bombers held a prominent place in the Warsaw Pact's operational doctrine. As early as World War II, the Soviet Red Army's assault aviation units had proven highly effective against the German Wehrmacht, particularly through the deployment of the Illyushin Il-2 STURMOVIK. As a founding member of the Treaty of Friendship, Cooperation, and Mutual Assistance, commonly known as the Warsaw Pact, Poland was deeply integrated with the Soviet Union both economically and militarily. It is therefore hardly surprising that the Polish Air Force became one of the first export customers of the new Sukhoi Su-7.

The first six Sukhoi Su-7BM aircraft were delivered to the Polish Air Force in June 1964. They formed the 1st Squadron of the 5th Fighter-Bomber Aviation Regiment (5. Pułk Lotnictwa Myśliwsko-Szturmowego, or 5th PLM-Sz). After this regiment was disbanded, the aircraft were redistributed to two other units: the 3rd Fighter-Bomber Regiment (3. Pułk Lotnictwa Myśliwsko-Bombowego), based in Powidz, and the 6th Fighter-Bomber Regiment (6. Pułk Lotnictwa Myśliwsko-Bombowego) in Poniatów.

Despite the shortcomings of the early FITTER series, the Polish Air Force was, on the whole, satisfied with the performance of the Su-7BM. This was largely due to the exceptional skill of Polish pilots, who were able to make full use of the aircraft's potential. It is therefore hardly surprising that Poland opted to acquire the Su-7's successor, the Su-20 (NATO code: FITTER-C). Beginning in the mid-1970s, the Su-20 gradually replaced the older FITTER variants and was primarily used as a tactical ground-attack aircraft. It played a key role in the modernization of Poland's air forces during the Cold War, serving both as a symbol of technological progress and as a building block in the transformation of the country's tactical air capabilities. Its deployment marked the beginning of the variable-geometry era in Polish military aviation and paved the way for the introduction of the final FITTER variant to serve in Poland: the Su-22M4, which remained in service with the Siły Powietrzne (Polish Air Force) until today.

NATO Code: FITTER-K / image by: Robert Kysela

Sukhoi Su-22UM4

Sukhoi Su-22UM3K - NATO Code: FITTER-G / *image by: Robert Kysela*

Generation change

Tensions between the West and the Soviet-dominated Warsaw Pact were disproportionately high during the 1980s. Consequently, the pressure on member states to comply with Soviet directives regarding the modernization of their air forces was immense. Although the People's Republic of Poland was officially a sovereign nation, it was Moscow that set the tone. Modernization measures were to be implemented between 1981 and 1985, with many outdated aircraft slated for replacement by more advanced Soviet-made models. According to these plans, Poland was to be equipped primarily with the Mikoyan-Gurevich MiG-23ML (NATO reporting name: Flogger) and to replace its aging Sukhoi Su-20s with the more capable Su-22M3. However, the leadership of the Polish Air Force was far from enthusiastic about these proposals. They were well aware that much more advanced aircraft were already in development in the Soviet Union, such as the Mikoyan-Gurevich MiG-29 (NATO Code: FULCRUM), a representative of a new generation of Soviet multirole fighters. Accordingly, there was little interest in equipping their own air force with systems that offered only marginal technological improvement over existing equipment.

FITTER-K

Although the contract for the purchase of the Su-22M3 (NATO Code: FITTER-H) and its twin-seat variant, the Su-22UM3, was ready for signature, the Polish side skillfully managed to delay its finalization through subtle stalling tactics. Pointing to the country's strained economic situation, Polish negotiators prolonged discussions with the Soviets until mid-1982, when an agreement was finally signed for the delivery of 100 combat aircraft. While the original deal still referred to the older Su-22M3 and its trainer version, it soon became clear that Poland would instead receive the latest models, the Su-22M4 and Su-22UM3K. The final contract was ratified the following year. In the end, the Polish delegation's strategy paid off: rather than outdated aircraft, they secured upgraded, state-of-the-art machines.

From the Polish point of view, the differences between the Su-20 and the Su-22M3 were too marginal to justify a meaningful upgrade. The appearance of advanced Western air superiority fighters such as the General Dynamics F-16 FIGHTING FALCON, as well as the Western counterpart to the FITTER, the Panavia TORNADO, further heightened concerns within the Polish Air Force command. Adding to the problem was the fact that the Su-22M3 did not feature the engine type favored by Poland for its Sukhoi strike aircraft. The export version of the Su-17M3, designated Su-22M3, was equipped with the Tumansky R-29BS-300 engine. Although this engine offered slightly more thrust than the Lyulka AL-21F-3, the advantage came at the cost of increased weight and higher fuel consumption. Given Poland's intention to operate both the Su-20 and the Su-22 side by side, introducing two different engine types within the same squadrons would have posed unnecessary challenges for maintenance crews and spare parts logistics. Additionally, integrating the larger Tumansky engine into the Su-22M3 required structural changes to the aircraft's rear fuselage, as the design had to accommodate a delayed tapering to house the engine. The primary reason behind the use of the Tumansky engine in the Su-22M3 was a production bottleneck affecting the Lyulka AL-21F-3, which was also in high demand for the newly introduced Sukhoi Su-24 (NATO designation: FENCER).

The final delivery consisted of 80 single-seat Su-22M4s and 20 two-seat Su-22UM3Ks. Poland subsequently placed an order for ten additional Su-22M4s, raising the total number of aircraft of this type in Polish service to over 110. Training of Polish pilots in the Soviet Union began as early as mid-1984, and the first aircraft was formally handed over to the Polish Air Force at the end of August that year.

Sukhoi Su-22M4 - NATO Code: FITTER-K / image by: Robert Kysela

Sukhoi Su-22UM3K - NATO Code: FITTER-G / *image by: Robert Kysela*

Sukhoi Su-22M4 / 8. ELT / *image by: Robert Kysela*

Polish FITTER-Units

The 6th Fighter-Bomber Aviation Regiment (6th PLM-B), based at Piła Air Base in the Greater Poland Voivodeship, was the first unit to be equipped with the new aircraft. In addition to its core mission, the regiment also served as an Operational Conversion Unit (OCU), making it responsible not only for the tactical training of pilots but also for developing operational deployment scenarios. As a result of these expanded duties, the 6th PLM-B became the largest FITTER regiment within the Polish Air Force, fielding a total of 36 Su-22M4s and nine Su-22UM3Ks.

The second unit to transition to the new Su-22s was the 40th Fighter-Bomber Aviation Regiment (40th PLM-B), stationed in Świdwin, a base located in the far northwest of Poland, near the Baltic coast, in the West Pomeranian Voivodeship. Unlike many air forces that use the term "Wing," the Polish Air Force traditionally refers to its flying units as "Regiments." The 40th PLM-B was equipped with 36 Su-22s, replacing the aging Su-7BKM fleet.
At the time, the regiment's structure comprised three squadrons (ELT - Eskadra Lotnictwa Taktycznego - Tactical Aviation Squadron)):

- The 1st and 2nd squadrons were operational units assigned to combat missions
- The 3rd squadron focused on flight and tactical training.

Each combat squadron typically consisted of 10 to 12 aircraft. The 40th PLM-B was regarded as one of Poland’s most capable formations in the field of tactical air warfare. In 2000, the regiment was disbanded as part of a wide-ranging organizational reform. Its personnel and aircraft were transferred to the newly established 21st Tactical Air Base (21st BLT) in Świdwin, which remains active today. The base is currently being upgraded to accommodate the Lockheed Martin F-35A HUSARZ. As a result, the last remaining Su-22s in Polish Air Force service have been temporarily relocated to Mirosławiec Air Base.

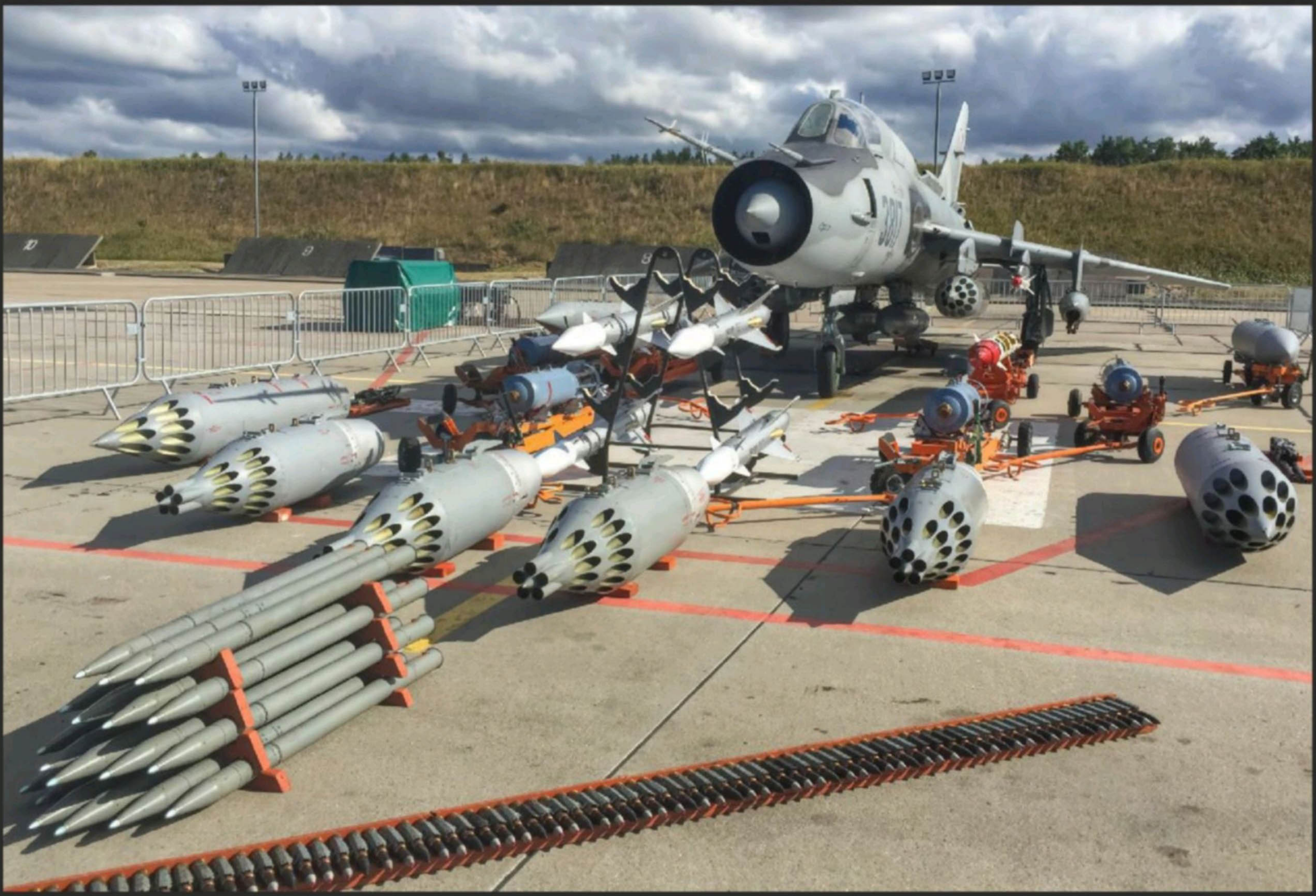
The next unit to receive the Su-22 was the 7th Bomber and Reconnaissance Aviation Regiment (7th PLB-R), based in Powidz. Unlike other regiments, only one of its combat squadrons and the training squadron were re-equipped with the new aircraft. The regiment’s second squadron continued operating the older Su-20s until 1997, primarily in the reconnaissance role.
The last Polish unit to transition to the Su-22 was the 8th Fighter-Bomber Aviation Regiment (8th PLM-B), stationed at Mirosławiec Air Base. In September and October 1988, the regiment took delivery of ten new Su-22M4s as part of a contract signed in 1986. Following the dissolution of the Warsaw Pact, all remaining regiments were restructured.

Sukhoi Su-22UM3K / 6. ELT / *image by: Robert Kysela*

Sukhoi Su-22M4 / 40. ELT / *image by: Robert Kysela*

Sukhoi Su-22UM3K / 21. BLT / *image by: Robert Kysela*

Sukhoi Su-22M4 - NATO Code: FITTER-K / image by: Robert Kysela



Weapons display / image by: Robert Kysela

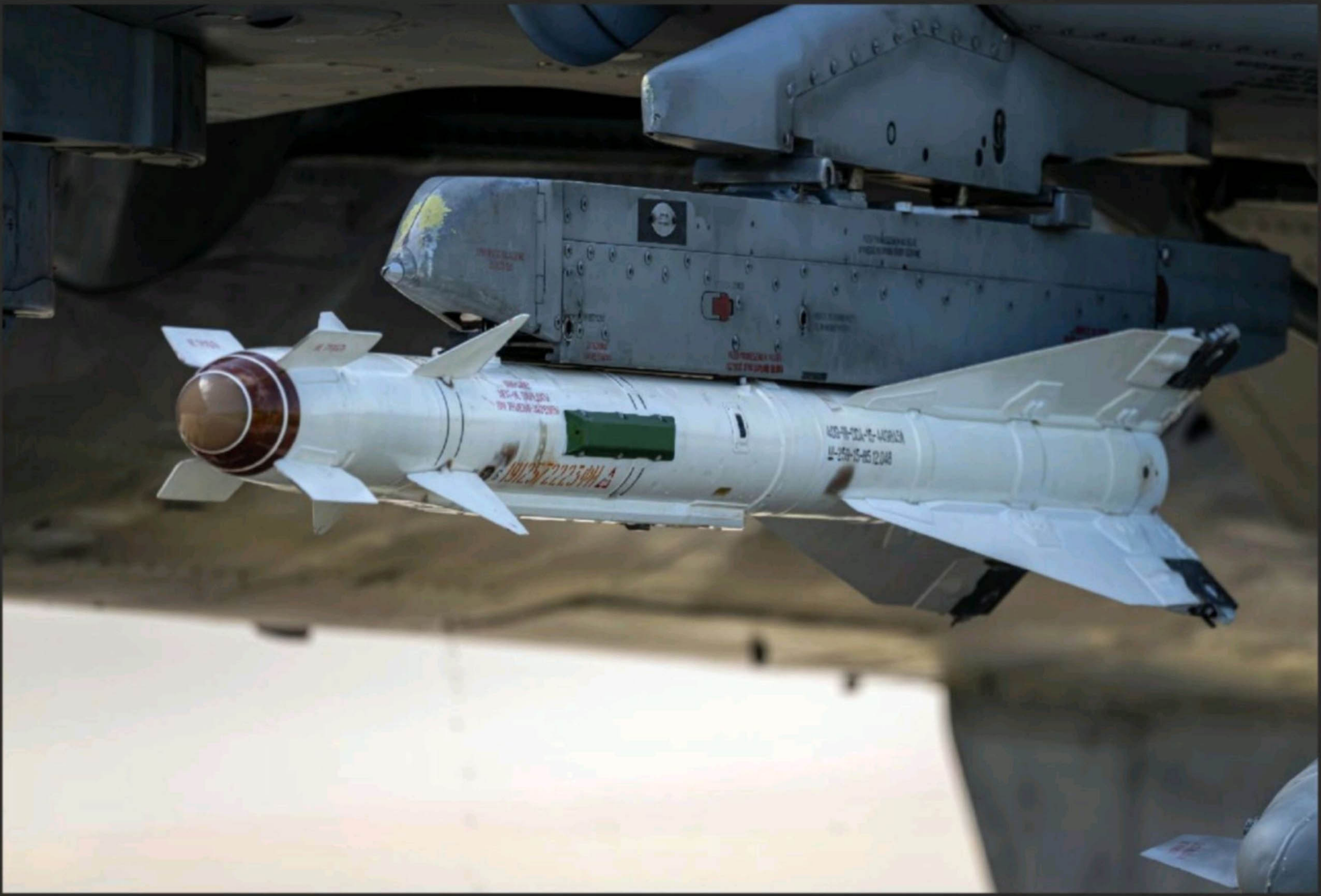
Modernization Efforts

Poland consistently sought to maintain a degree of technological and industrial autonomy within the Warsaw Pact. This aspiration was particularly evident in the field of military aviation technology. The Polish aerospace industry made considerable efforts to remain technologically up to date, to develop indigenous aircraft designs, to license-produce modern combat aircraft, and, most notably, to ensure that maintenance, repair, and overhaul (MRO) of its operational fleets could be carried out domestically. In the case of the Su-22, responsibility for routine overhauls as well as extensive maintenance operations was assigned to Wojskowe Zakłady Lotnicze No. 2 in Bydgoszcz Throughout the Su-22's more than four decades of service in the Polish Air Force, several attempts were made to modernize the platform. However, these efforts ultimately resulted in only a limited upgrade to NATO standards. The modifications included, among others, the following:

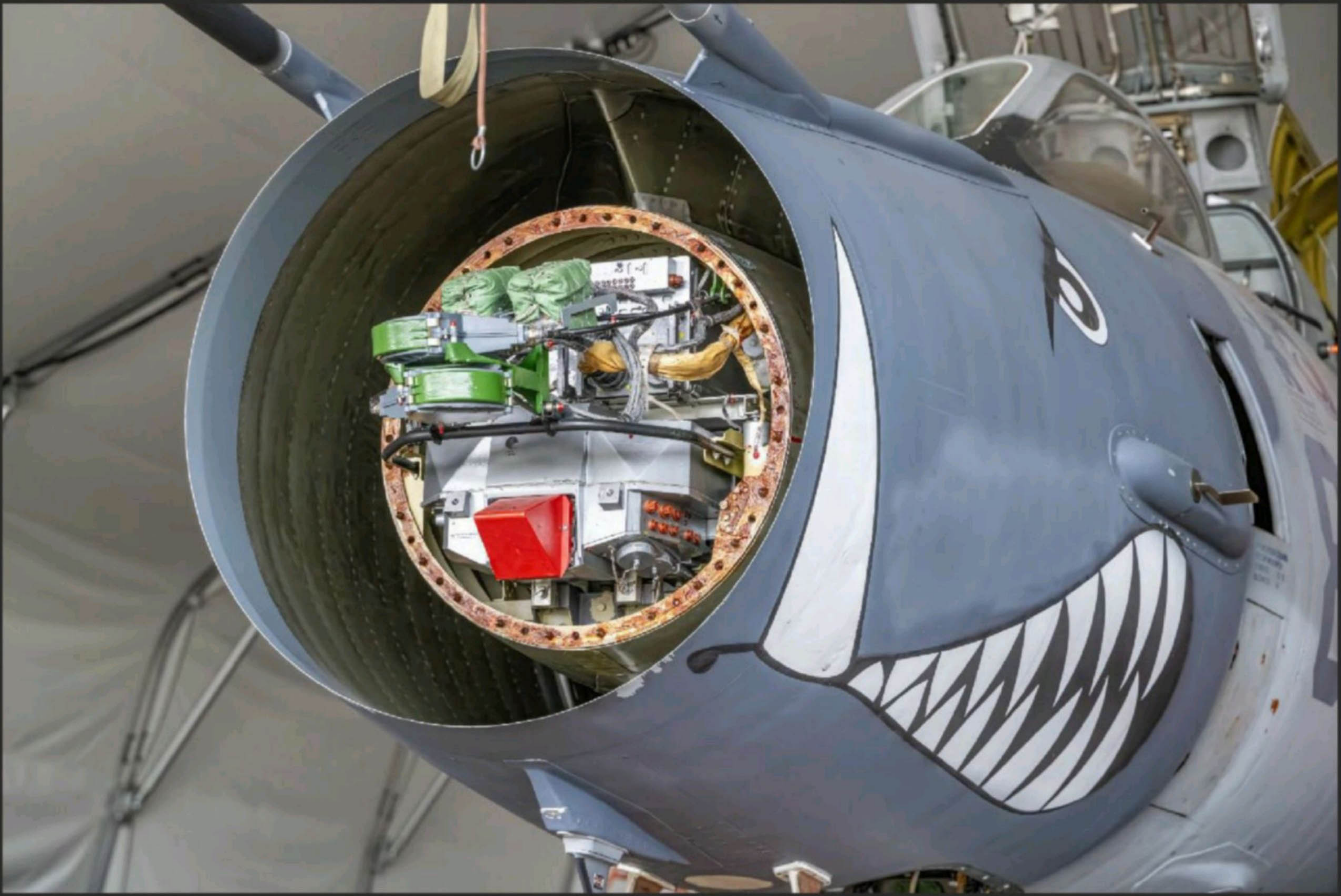
- Replacement of the RSBN-7S instrument landing system with a Bendix KTU-709 TACAN unit
- Substitution of the RSDN-10 navigation receiver with a GPS module manufactured by the U.S. company Trimble
- Replacement of the obsolete "Parol" Identification Friend or Foe (IFF) system with the domestically developed Radwar SC-10 SUPRASL IFF system

With regard to armament, the Su-22M4 can employ a wide range of weapons. Thanks to its Orbita-20-20 digital mission computer, the M4 is capable of deploying not only a broad spectrum of unguided munitions but also various types of precision-guided weapons. These include laser-guided air-to-surface missiles such as the Kh-29L (NATO reporting name: AS-14 KEDGE), which uses semi-active laser homing and has an effective range of up to 10 km, as well as the Kh-25ML (AS-10 KAREN). The latter is comparable in range and guidance method to early variants of the U.S. AGM-65 MAVERICK. For self-defense, the Su-22M4 can be equipped with up to two short-range, infrared-guided air-to-air missiles of the type R-60M (AA-8 APHID, developed by GOSNIIAS / Vympel NPO). This compact missile was specifically designed to provide short-range defensive capability for frontline combat aircraft and has an effective engagement range of approximately 8 kilometers.

One of the most technically intriguing weapons pods available for the Su-22M4 was the SPPU-22 (Russian: СППУ-22; Samolyotnaya Podvizhnaya Pushéchnaya Ustanovka – "movable aircraft gun pod"). This pod contains two GSh-23L twin-barrel autocannons of 23 mm caliber, which can be mechanically depressed up to 30 degrees. Uniquely, the SPPU-22 can also be mounted in a rearward-facing configuration, a tactical peculiarity that could present a nasty surprise for any pursuing aircraft.



GMKB Wympel R-60M - NATO Code: AA-8 APHID / image by: Robert Kysela



Klyon-54 Laser targeting system/-designator / image by: Robert Kysela

FITTER in NATO Service

The operational doctrine of the Polish Air Force, developed in close coordination with the Soviet General Staff, envisioned the deployment of the Su-22M4 at short to medium ranges in a battlefield interdiction role. In such missions, aircraft were to penetrate the target area at high speed and at extremely low altitude, ideally based on a pre-programmed and precisely defined flight plan. Unlike its Western counterpart, the Panavia TORNADO, the Su-22M4 lacked a terrain-following radar (TFR). However, it was equipped with a capable autopilot system that enabled fully automated and highly accurate ingress and weapons delivery, provided that the target coordinates were known in advance and correctly uploaded into the system. Upon completing what was typically a single attack run, the pilot was instructed to disengage and egress the combat area at maximum speed. These so-called "hit-and-run" missions were designed to minimize the aircraft's exposure to enemy air defenses and thereby reduce the risk of losses.

How the Su-22M4 would have performed in a large-scale, high-intensity combat scenario, comparable to the current conflict in Ukraine, thankfully remains an unanswered question. With the end of the Cold War and the formal dissolution of the Warsaw Pact on 1 July 1991, a new era began for the Polish Air Force. This period was marked by structural transformation, strategic realignment, and a gradual integration into Western alliance systems.

While most Eastern European operators rapidly phased out their Su-22 fleets following the collapse of the Warsaw Pact, Poland initially saw no compelling reason to retire this proven platform—due in no small part to financial considerations. With over one hundred aircraft remaining in active service, the Polish Air Force maintained a potent strike capability that could neither be quickly replaced nor was intended to be.

Nevertheless, the Su-22 fleet was gradually reduced over time. Between Poland's accession to NATO in 1997 and the planned retirement of the type in 2025, the number of operational aircraft decreased to 18 units, comprising twelve Su-22M4s and six two-seat Su-22UM3Ks, all based at the 21st Tactical Air Base (21. Baza Lotnictwa Taktycznego, 21. BLT) in Świdwin.

By now, the Su-22 is technologically outdated compared to modern multirole combat aircraft. Its avionics, sensors, and weapons systems no longer meet current operational standards, and the procurement of spare parts has become increasingly burdensome. That Polish maintenance crews have managed to sustain an acceptable level of operational readiness to this day is a testament to their high level of training and unwavering professionalism.

Sukhoi Su-22M4 / NATO Code: FITTER-K / *image by: Robert Kysela*

Sukhoi Su-22M4 - NATO Code: FITTER-K / *image by: Robert Kysela*

Conclusion

The Sukhoi Su-22 FITTER was never considered an easy aircraft to fly, and maintaining its aging systems routinely posed significant challenges to ground crews. And yet, complaints were seldom heard from either Polish pilots or technicians. For over four decades, they ensured that this variable-geometry strike fighter remained a reliable asset within the national air defense architecture. Quite the contrary: the Polish Air Force has showcased its FITTERs with visible pride at numerous national and international airshows over the past 30 years. Furthermore, Poland regularly deployed the aircraft in NATO exercises, demonstrating convincingly that, even in the 21st century, the aging platform still retained operational value.

With the planned retirement of the last Su-22M4 FITTER-K in 2025, one of the final Cold War icons, and one of the last Soviet-designed aircraft in active service, will take its leave. The distinctive silhouette of the Su-22, with its variable-sweep wings, is expected to make a final public appearance at the Radom Airshow in August 2025. For aviation enthusiasts and military history observers alike, this date marks a unique opportunity to witness the FITTER in flight one last time.

Robert Kysela

Sukhoi Su-22M4 - NATO Code: FITTER-K / image by: Robert Kysela

21. BAZA LOTNICTWA TAKTYCZNEGO im. mjr pil. Stefana STECA
Świdwin

off. Patch: 21. Baza Lotnictwa Taktycznego

RAMSTEIN FLAG

2025

March 31 - April 11, 2025
Leeuwarden Air Base / Netherlands

Eurofighter TYPHOON FrGR.Mk 4 / *image by: Alex van Noije*

On Monday, 31 March, 2025, the multinational exercise RAMSTEIN FLAG 2025 officially commenced at Leeuwarden Air Base in the Netherlands. In addition to Leeuwarden, several other bases across Europe are actively participated in the operation. In Denmark, flights were conducted from Skrydstrup Air Base, while in the United Kingdom, RAF Marham and RAF Fairford serve as key locations for exercise-related missions. A significant number of aerial refueling tankers and surveillance aircraft were also involved, operating out of various bases throughout Europe to support the large-scale effort. More than ninety fighter jets from numerous NATO member states were taking part in what was considered one of the alliance's most comprehensive air exercises to date. Spanning two weeks, RAMSTEIN FLAG 2025 was designed to prepare NATO forces for high-intensity conflict, simulating a major war scenario over European territory. The exercise went far beyond traditional air operations. It included integrated air defense drills, incorporated land- and sea-based missile systems, and placed strong emphasis on air battle management, which played a critical role in coordinating the complex multinational operations.

Story: Joris van Boven & Alex van Noije

Images by: Björn Trotzki, Alex van Noije & Joris van Boven

WG CDR G MONTGOMERY
RESCUE

The center of the exercise

Lieutenant General André 'Jabba' Steur, Commander of the Royal Netherlands Air Force, offered a brief insight into the importance of RAMSTEIN FLAG exercise for both the Netherlands and its international partners. A seasoned fighter pilot with over 20 years of experience, Lt. Gen. Steur has witnessed firsthand how the global security landscape has evolved over the past decade. He explained:

> *"Today's geopolitical developments demand that NATO, as an alliance, is able to respond collectively, swiftly, and decisively. Ramstein Flag allows us to train for exactly that - a coordinated NATO response in the event of an attack on a member state, known as an Article 5 scenario."*

During the exercise, around 45 aircraft were participating at Leeuwarden Air Base, with approximately 30 fighters flying in each 'wave'. Two waves of aircraft were launched per day.

The participating nations and their aircraft:

- United States (Europe) – Lockheed Martin F-35A
- Germany – Eurofighter EF2000
- Finland – Boeing F/A-18 HORNET
- France – Dassault Aviation RAFALE B/C
- Greece – Lockheed Martin F-16C FIGHTING FALCON
- The Netherlands – F-35A and MQ-9
- Sweden – Saab JAS-39 GRIPEN

Dassault Aviation FALCON FA-20 / *image by: Alex van Noije*

Support for the mission at Leeuwarden was also provided by the company Draken Europe, a subsidiary of Draken International with a Dassault FALCON FA-20. This company provides adversary and target representation, flight training, threat simulations and electronic warfare support.

> *"There's a lot happening at Leeuwarden," Steur notes. "By training together, we, as NATO partners, work on the core themes of Ramstein Flag: integration, cooperation, leadership, and night operations."*

The exercise involved between 700 and 900 military personnel stationed at Leeuwarden, who accompanied their respective units and stayed in the region during the operation. Beyond Leeuwarden, RAMSTEIN FLAG extended to several other airbases throughout the North Sea region, from Denmark to the United Kingdom.
During the exercise, participating pilots trained for a variety of mission types, including:

- **Air defense** to deny enemy fighters access to specific areas
- **Airspace security** to protect against missile threats
- **Tactical information** sharing
- **Rapid deployment** in response to emerging threats

RAMSTEIN FLAG 2025
NATO
OTAN
ADVA
TRAINING EXERCISE

Commodore Marcel "BO" van Egmont / *image by: Joris van Boven*

Adapting to a changing world

Over the past decade, the global security environment has changed dramatically. Commodore Marcel 'BO' van Egmond, Commander of Air Combat Command (C-ACC) of the Royal Netherlands Air Force (RNLAF), reflected on how the world, and NATO's role within it, has evolved. Like Lieutenant General Steur, Commodore van Egmond is a highly experienced fighter pilot, having flown the Lockheed Martin F-16MLU FIGHTING FALCON for many years and now piloting the Lockheed Martin F-35A LGHTNING II.

Commodore van Egmond emphasized the significance of hosting RAMSTEIN FLAG in the Netherlands:

> *"We've been conducting Frisian Flag exercises for many years with great success. It's a true honor for the Netherlands to now host Ramstein Flag. Being recognized as capable of supporting and organizing such a high-quality exercise is a milestone. We're proud to meet the standards needed to provide our pilots with world-class training, especially in this operational theater, and to do so in a highly organized and effective way."*

He highlighted the geopolitical shifts that have led to the need for exercises like RAMSTEIN FLAG:

> *"I flew the F-16 until last year and participated in many exercises. Just last week, I was looking forward to this one together with Air Marshal Stringer, Deputy Commander of NATO Allied Air Command. As we sat through the mission briefing, we were both so energized, the only thing we wanted to do was jump into a jet and fly ourselves. We could clearly see the relevance and urgency of this exercise."*

The C-ACC continued:

> *"This exercise is a clear reflection of the state of today's world. I think everyone understands that the world we live in today is very different from what it was ten or twelve years ago. 2014 marked a turning point. We had envisioned a peaceful, stable Western world and a strong transatlantic alliance, one that had enjoyed more than 80 years of relative peace in our region."*

The global focus was different then, van Egmont recalled. NATO members were primarily concerned with deploying forces far from home, engaging in peacekeeping, counterinsurgency, and nation-building missions in places where political instability had spiraled out of control.

> *"That reality has shifted," he says. "Just look at the current situation in Europe. The war on NATO's eastern flank, near Ukraine, is happening incredibly close to our home territory, just an hour and a half flying time from here."*

Lockheed Martin F-35A LIGHTNING II / *image by: Bjoern Trotzki*

Lockheed Martin F-35A LIGHTNING II / *image by: Alex van Noije*

Lockheed Martin F-35A LIGHTNING II / *image by: Joris van Boven*

Defending by detterence

The beginn of the conflict in Ukraine in 2022 marked a major turning point in Europe's collective sense of security, sayed C-ACC van Egmond.

> *"Within four hours, we were flying missions from our home base. We'd return the same day, sleep in our own beds, and fly out again the next morning, this time to Poland, supporting NATO's deterrence posture. We were there to affirm our strength as an alliance and to make it clear that any incursion on allied territory would not be tolerated."*

Much has changed since then. Today, during RAMSTEIN FLAG, NATO forces have come together at Leeuwarden to demonstrate resolve, joint readiness, and the commitment to train as realistically as possible, not just nationally, but as a unified alliance. One major evolution from previous exercises like Frisian Flag is the inclusion of night operations, which were not traditionally part of the training. This time, however, nighttime training played a key role, allowing NATO units to operate as one cohesive force under low-visibility conditions, reflecting real-world demands.
The C-ACC also addressed the challenge of limited airspace, which required creative planning and coordination across multiple airbases, more than typically used during past exercises.

> *"In this exercise, we plan missions remotely. We develop the plan together, brief it together, execute it together, and debrief together. That's how we improve, not only at what we already do well, but also in understanding what our teammates can and cannot do. It's like football: each player may be excellent individually, but only with strong coaching and training can they become world champions as a team."*

> *"Some units may not have the same capabilities or equipment, as every nation brings different aircraft and assets. That's why we train to understand the strengths and limitations of each platform, and to find the best way to complement each other. This way, the whole becomes greater than the sum of its parts."*

Van Egmond emphasized that deterrence isn't just about declarations on paper, it's about action!

> *"Deterrence works when trained, capable units can operate effectively as a team and prove it. It's not enough to simply show up. Real deterrence comes from demonstrating interoperability, readiness, and the willingness to act. That's what we're doing here: training together to show that NATO's commitment to its members is unwavering, no matter what challenges come our way."*

Eurofighter EF-2000 / *image by: Alex van Noije*

Eurofighter EF-2000 / *image by: Bjoern Trotzki*

Objectives of RAMSTEIN FLAG

The planning and execution of RAMSTEIN FLAG 2025 was led by Lieutenant Colonel Wim van Kampen of the Royal Netherlands Air Force. He serves at NATO HQ AIRCOM within the A7 Division, which is responsible for the planning and development of exercises across the Allied Air Command community. His operational counterpart was Lieutenant Colonel Martin Friis of the Royal Danish Air Force, based in the A3 Division at HQ AIRCOM. While van Kampen focused on exercise design and structure, Friis was charged with operational planning, essentially designing how NATO forces would go to war, ensuring they are capable of executing those plans immediately if needed.

RAMSTEIN FLAG 2025 (RAFL25) was designed to test and train allied air forces in realistic, high-pressure scenarios, particularly those involving Article 5 of the NATO treaty, which mandates collective defense in response to an attack on a member state.

Airbus A330 MRTT / image by: Bjoern Trotzki

Key areas of training included:

- Counter Anti-Access/Area Denial (C-A2AD)
- Integrated Air and Missile Defense (IAMD)
- Agile Combat Employment (ACE)
- Air Command and Control
- Information sharing across allied forces

According to Lt Col van Kampen, a primary objective was the integration of these five lines of effort into cohesive, scenario-based operations. RAFL25 was not limited to airpower, it fully integrated Air, Land, Maritime, Cyber, and Space domains, all working together in a synchronized, information-driven environment.
From space and cyber specialists to Joint Terminal Attack Controllers (JTACs), from a Dutch naval frigate operating in the North Sea to more than 90 allied aircraft flying from 12 airbases across the NATO area, the scale and complexity of RAMSTEIN FLAG was unprecedented.

Eurofighter EF-2000 TYPHOON FGR.Mk4 / image by: Alex van Noije

Frisian Flag vs Ramstein Flag

In previous editions of FRISIAN FLAG, the entire exercise was conducted from a single location. Units operated exclusively from Leeuwarden Air Base, using a designated section of airspace. Mission planning, execution, and debriefing all took place on-site. During RAMSTEIN FLAG, however, the exercise has expanded significantly, even though the participating units still used the same core airspace as in FRISIAN FLAG. The major difference lied in the distributed nature of operations, as units flew from multiple locations across Europe.

Lieutenant General Andre Steur explaind:

> *"NATO asked 323 Squadron to organize Ramstein Flag because of its extensive experience running Frisian Flag. It serves as a blueprint for future NATO exercises. 'Ramstein' refers to the air base in Germany where NATO coordinates allied air operations. This year, Ramstein Flag replaces Frisian Flag in the Netherlands. 'Frisian' refers to Friesland, the home province of Leeuwarden Air Base. While the number of participants at Leeuwarden hasn't grown significantly compared to previous editions, the scale of the exercise has because our allies are now flying from air bases all over Europe."*

In the Netherlands, key locations involved include AOCS Nieuw Millingen and Eindhoven Air Base. Internationally, aircraft were operating from bases in Denmark, Germany, France, and the United Kingdom. In total, 15 NATO locations were participating. Previously, around 60 aircraft flew from Leeuwarden alone. Now, more than 90 aircraft were participating across different countries, flying integrated missions under shared scenarios. This increase in complexity presented new challenges, especially in communication and coordination. With units dispersed geographically, synchronized timing and accurate planning become critical to mission success.

> *"This kind of coordination is new to many participants," says Steur. "That's why it's such valuable training. It demands fast, precise communication to ensure everyone is in the right place, doing the right thing, at exactly the right time."*
> *Another key difference: while Frisian Flag was a daylight exercise, Ramstein Flag includes evening and night missions, a deliberate shift to increase realism.*

> *"It's important that we and our allies train as realistically as possible," Steur notes. "Right now, that means operating in the dark. That's why we say: 'Train as you fight.'"*

At Leeuwarden, the missions were flown in two waves daily, between 16:30 and 23:30. These two weeks in spring 2025 marked the only scheduled evening flying period for the air base that year.

RAMSTEIN FLAG 25
RED BARONS

TaktLwG 71 "R" Patch / *image by: Bjoern Trotzki*

ATO
TAN
CISE
RAMSTEIN FLAG 2025
NATO
OTAN
ADVANCED AIR COMBAT TRAINING EXERCISE
VAN K

Lt. Col. Wim van Kampen / *image by: Joris van Boven*

Counter Anti-Access / Area Denial

One of the top priorities of RAMSTEIN FLAG was training in Counter Anti-Access/Area Denial (C-A2AD) and Integrated Air and Missile Defense (IAMD). Forward airbases are increasingly threatened by cruise and ballistic missiles, which adversaries can use to establish anti-access zones and enforce no-fly areas. C-A2AD operations aimed to neutralize enemy infrastructure, deter aggression, and eliminate restrictions that limit the freedom of movement for friendly forces. The goal was to ensure that Allied units can operate safely and effectively within contested regions.
Because successful C-A2AD missions rely on the coordinated use of all warfighting domains, they were a central focus of this large-scale exercise.

Lieutenant Colonel Wim van Kampen explained the concept in simple terms:

> *"If you have a fence around your house, it keeps people out. But if someone needs access to the house, they'll have to remove the fence. That's what we want in a C-A2AD scenario: to remove the barriers so our forces can move freely. It's a metaphor for gaining freedom of movement in hostile environments."*

Typically, defensive systems are arranged in layered "bubbles" to protect key strategic areas. These zones often contain a concentration of offensive capabilities, including cruise and ballistic missiles, and air defense systems, which an adversary will seek to protect.

Van Kampen explained:

> *"In those protected areas, the enemy likely has missiles capable of targeting our ships, our ground troops, and our aircraft. These capabilities directly threaten our ability to maneuver. That's why our first objective is to dismantle or disable those defensive systems, to reestablish our freedom of action. That is the essence of C-A2AD."*

This operational discipline is still relatively new within NATO.

> *"The doctrine has been developed by AIRCOM," said van Kampen. "And while this isn't our first time training it, this is the first time we are applying it at this scale, with this many participating units. It is a fully integrated multi-domain operation."*

He added:

> *"This is not just about air power. These missions involve land, sea, cyber, and even space-based capabilities to support the air component. Ground forces, naval platforms, satellite data, cyber operations, and even special forces all play a role. The objective is to probe and dismantle the enemy's ability to defend themselves across all domains."*

Eurofighter EF-2000 / *image by: Bjoern Trotzki*

Saab JAS-39C GRIPEN / *image by: Alex van Noije*

Dassault Aviation RAFALE C / *image by: Bjoern Trotzki*

Integrated Air and Missile Defense

Integrated Air and Missile Defense (IAMD) was another key focus of the exercise. IAMD is designed to integrate multiple joint force capabilities to protect designated areas from rapidly evolving air and missile threats. It relies on a complex network of sensors and defense assets connected through multiple communication pathways to command and decision systems, which assess and determine the most effective way to counter incoming threats.

The IAMD framework is built on a layered defense system that combines short-, medium-, and long-range capabilities. Lieutenant Colonel Martin Friis of the Danish Air Force explained that this concept was tested during the initial phase of the exercise:

> *"The first three days were dedicated to integrated air and missile defense. 'Integrated' means defending our airspace and territory with a mix of aircraft and ground- or sea-based air defense systems, such as Surface-to-Air Missiles (SAMs)."*

Lockheed Martin F-35A / *image by: Alex van Noije*

The exercise was conducted in what is known as a semi-permissive environment. Lt Col Friis outlined the three categories of operational environments relevant to such scenarios:

> - ***Permissive environment:*** *"Think of places like Afghanistan, where there was no significant air defense. We could conduct operations freely, that's a permissive environment."*
> - ***Non-permissive environment:*** *"At the other extreme, we face heavily defended areas with layered short-, medium-, and long-range SAM systems capable of engaging us. Penetrating such airspace is extremely difficult, risky, and resource-intensive."*
> - ***Semi-permissive environment:*** *"This is a middle ground. We assume limited enemy air defenses, and that we'll only need to establish our defense systems temporarily, just for the duration of our operations in that area."*

These simulated conditions allowed NATO forces to realistically train for complex and high-threat scenarios, reinforcing their ability to operate effectively across a spectrum of environments.

Agile Combat Employment (ACE)

Agile Combat Employment (ACE) has emerged as a critical focus in recent operational planning. Although ACE was one of the key objectives of this year's Ramstein Flag exercise, it was ultimately not executed, as explained by Lieutenant Colonel Martin Friis (RDAF):

> *"We're trying to educate teams on how to implement ACE so they better understand the concept — both within the context of this exercise and in a real conflict. ACE was a core objective in the initial release concept for the exercise, but due to the relocation of several aircraft and other logistical constraints, we were unable to implement it this time."*

ACE is an operational maneuver strategy designed to enhance both resilience and survivability, while ensuring that air combat power can be projected from both home stations and dispersed locations. This can include Main Operating Bases (MOBs), Deployed Operating Bases (DOBs), and Contingency Locations (CLs). Successful execution of ACE requires a flexible, coordinated approach between the deploying forces and the host or receiving bases.

Lt Col Friis elaborated:

> *"ACE essentially means flying an aircraft into another country, having it serviced, re-armed, and reloaded there and then returning to the mission. Unfortunately, we weren't able to carry this out during this exercise, but we will emphasize it more in future iterations. The rationale behind ACE is simple: if you park your aircraft in the same place every day, your adversary will figure that out and target it. The goal of ACE is to remain unpredictable by constantly moving aircraft between different locations."*

In practical terms, ACE can range from shifting aircraft parking spots on the same base to launching from one base and landing at another to refuel or rearm. This requires extensive training and coordination, especially because aircraft may be serviced by technicians from other nations unfamiliar with that specific airframe.
Moreover, ACE presents significant logistical challenges. Spare parts, munitions, and fuel must be pre-positioned at various locations, ensuring aircraft are mission-ready regardless of where they land.

Lt Col Friis highlighted the broader possibilities of ACE:

> *"It's not limited to standard airbases - ACE includes operating from remote or austere environments like short runways and even highway strips. Scandinavian countries, in particular, have developed strong capabilities in this area. Constantly moving aircraft demands detailed planning and rigorous training, but it's essential for survival in a contested environment. If the enemy doesn't know where you are, you maintain the upper hand."*

Structure and intensity built-up

Like many other large-scale military exercises, RAMSTEIN FLAG followed a gradual escalation in intensity over its two-week duration. The designated exercise airspace was located north of the Netherlands, over the North Sea, stretching from the west coast of Denmark nearly to the United Kingdom. The area spanned approximately 360 kilometers north to south and 180 kilometers east to west.

This region is part of one of the busiest civilian airspaces in Europe, which imposes limitations on the size of the military training area. Nevertheless, the location provided sufficient space to simulate complex, large-scale operations across multiple domains. The structure of the exercise mirrored the phases of a typical military conflict, as explained by Lieutenant Colonel Martin Friis:

> *"The scenario generally involves the 'Blue Force' starting from their home country in the north and engaging the 'Red Force' advancing from the south. The exercise follows the logical buildup of a real-world conflict."*

- Phase 1 (Days 1–3): Integrated Air and Missile Defense
  During the initial days, the focus was on defending allied territory, with forces tasked with repelling aerial threats through a mix of air and ground-based assets.
- Phase 2 (Days 4–7): Counter Anti-Access/Area Denial (C-A2AD)
  The second phase saw allied forces striking back against simulated threats positioned in the southern portion of the area, including the use of aircraft and naval elements on the Dutch side. The objective was to neutralize enemy capabilities and regain freedom of movement.
- Phase 3 (Final 2 Days): Air Zero / Air Power Contribution to Land Operations (APCLO)
  In the final stage, the focus shifted to supporting ground forces as they advanced into territory cleared during the C-A2AD phase.

> *"If NATO is attacked, the fighting will likely begin on the ground," said Lt Col Friis. "The army will request our support to provide air cover during their operations."*

Throughout the exercise, participants alternated roles between 'Blue Force' and 'Red Force', ensuring comprehensive training for both offensive and defensive scenarios. This role reversal also enhanced interoperability, as all participants were required to coordinate and operate as a cohesive joint force across all warfare domains.

Lockheed Martin F-16C FIGHTING FALCON / image by: Alex van Noije

Lockheed Martin F-35A LIGHTNING II / image by: Alex van Noije

A commander's perspective

Commodore van Egmond reflected positively on the recently concluded RAMSTEIN FLAG exercise, praising both the operational execution and the progress made by participants:

> *"We have the exercise behind us, and it's been a great success so far. I'm very happy with the outcome. The fact that we were able to fly nearly all missions as planned, with very few aborted flights, is a great achievement."*

Van Egmond emphasized that, as with any large-scale exercise, lessons learned were an essential part of the process:

> *"There are always many lessons identified in exercises like these. If you ask what could be improved, I'd say primarily the tactics and training level of some of the participants. But the good news is: this group is growing fast."*

He noted that some of the newer capabilities, such as Integrated Air and Missile Defense (IAMD) and Counter Anti-Access/Area Denial (C-A2/AD) operations, presented challenges initially, but showed significant improvement even within the first few days:

> *"It was the first time we integrated air and missile defense on this scale. By day three, we were already performing much better than on day one, showing a clear learning curve across the board."*

Van Egmond also expressed the need for enhanced threat simulations, particularly more realistic air and missile defense systems, to sharpen the training. Additionally, he pointed out constraints in airspace availability and would like to see an increase in tanker support and enabler assets in future iterations:

> *"We are operating in a very limited airspace. If we want to scale this even further, we'll need more room and more support assets in the air."*

A significant milestone was also achieved during RAMSTEIN FLAG: the first live exchange of combat data between a Dutch-operated F-35A and the national command system Keystone, outside of U.S. territory. During the second week of the exercise, an F-35A identified a ground target and transmitted the data in real-time to the Keystone system. This system automatically relayed the information to an army unit, which then neutralized the target using the PULS rocket artillery system, all within a matter of minutes. This test was conducted in collaboration with the U.S. Air Force, Lockheed Martin, and the Dutch research organization TNO. It marked the first successful demonstration of this multi-domain data integration in Europe using F-35 aircraft.

312
ZK312
340

Eurofighter EF-2000 TYPHOON FRG.Mk 4 / image by: Joris van Boven

Conclusion

Hosted by the Royal Netherlands Air Force (RNLAF), RAMSTEIN FLAG 2025 (RAFL25) brought together approximately 2,000 personnel and over 90 aircraft from more than 15 NATO nations, operating from 12 Allied air bases across Europe. Building on the foundation laid by the inaugural RAMSTEIN FLAG, this year's iteration focused on strengthening NATO's capabilities in Counter Anti-Access/Area Denial (C-A2/AD), Integrated Air and Missile Defense (IAMD), Agile Combat Employment (ACE), and multinational information sharing. The exercise scenarios provided a demanding, high-intensity training environment, pushing participants to execute complex missions across all warfighting domains: air, land, maritime, cyber, and space.
RAFL25 not only built on lessons learned during RAFL24 but also incorporated operational insights from the ongoing war in Ukraine. The overarching objective was clear: to gain and maintain air superiority in any contested area of operations.

The successful execution of RAFL25 reinforces NATO's ability to respond rapidly and effectively to emerging threats. By integrating advanced tactics and enhancing collaboration across member nations, the exercise significantly contributed to the Alliance's deterrence and defense posture.
As NATO continues to adapt to a shifting security landscape, exercises like RAMSTEIN FLAG remain essential for ensuring that Allied forces are ready and able to defend the territory and populations of the Alliance.

Joris van Boven & Alex van Noije

FIAT AVIAZIONE G.91

FIAT G.91R / image by: Danilo Bof

In 1953, NATO issued a call for proposals under the name NATO Basic Military Requirement 1 (NBMR-1), seeking the development of a light combat aircraft. The objective was to create a standardized fighter-bomber for the Western defense alliance.

Enticed by the prospect of a lucrative contract, seven manufacturers submitted designs. Among them were three leading French companies - Dassault, Sud-Est, and Breguet, as well as the American Northrop company. Italy entered the competition with two proposals: a sleek mid-wing aircraft by a company named Aerfer and the eventual winner, the G.91, designed by FIAT Aviazione.

Story: Danilo Bof, Emanuele Ferretti
Images by: Danilo Bof, Robert Kysela & Marco Farè

Development

The NATO NBMR-1 specification called for a light combat aircraft with a maximum takeoff weight of 5.5 tons and a top speed of Mach 0.95, capable of operating from short and unprepared runways. Seven designs were submitted, including the Italian entries Aerfer SAGITTARIO 2 and the FIAT Aviazione G.91. On June 30, 1955, the Advisory Group for Aerospace Research and Development (AGARD) announced the three finalists:

- Breguet 1001 TAON
- Dassault ETENDARD VI
- Fiat G.91

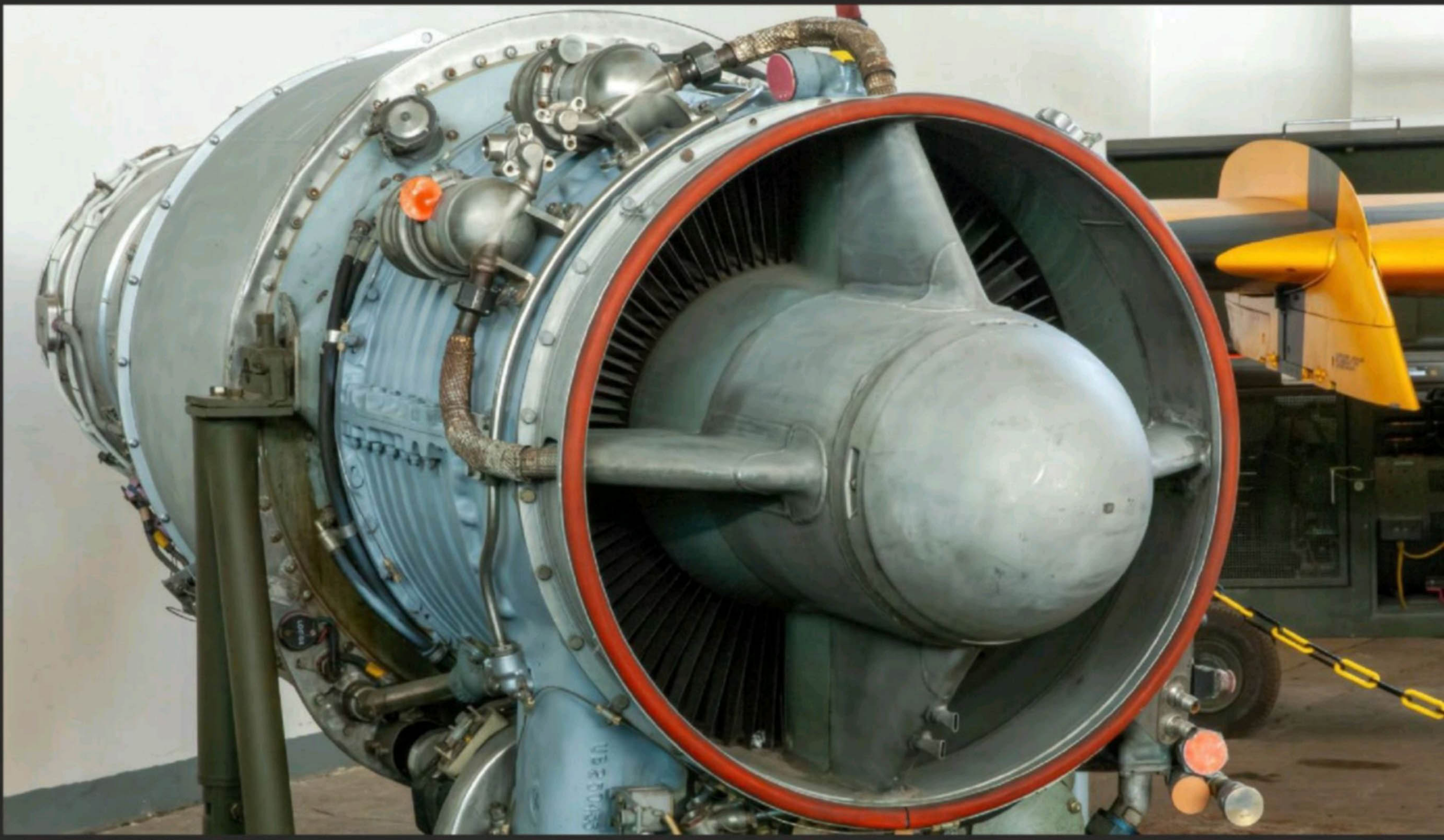
Three prototypes of each aircraft were ordered. The FIAT G.91 was the first combat aircraft to be fully designed and built in Italy after World War II. The project was led by engineer Giuseppe Gabrielli. On August 9, 1956, the first G.91 prototype took off from Caselle Airport near Turin, with Ing. Gabrielli in attendance. The maiden flight was piloted by Major Riccardo Bignamini. On February 20, 1957, during his 24th flight, Bignamini broke the sound barrier four consecutive times at an altitude of 9 000 feet.

In January 1958, NATO declared the FIAT G.91 the winner of the competition. Its rugged construction and ability to operate from unpaved runways and even highway strips were key factors in the decision. This capability was fully aligned with NATO doctrine at the time, which anticipated that, in the event of conflict with the Warsaw Pact, enemy forces would swiftly target and destroy NATO airbases. Therefore, future combat aircraft had to be able to take off and land from improvised airstrips and grass runways.

The G.91 could come to a stop within just 600 meters upon landing, allowing it to operate from short or partially repaired runways. In addition to its excellent flight performance, the aircraft featured a simple and efficient design, which simplified production and kept manufacturing costs low. Its modular construction, considered advanced for its time, allowed for a wide range of configurations and mission profiles with minimal structural changes.

Powering the aircraft was the Bristol Siddeley Orpheus 801/803 turbojet engine, produced under license by FIAT as the 4023. As this engine had no afterburner it delivered 22.24 kN of thrust, it enabled the G.91 to reach speeds just a little bit below the speed of sound.

FIAT G.91R/1 / image by: Marco Farè


Bristol Siddeley Orpheus 803 / *image by: Robert Kysela*

G-45/4
MM6205

ACHTUNG OPTISCHES GLAS
CAUTION OPTICAL GLASS
KAMERARAUM
CAMERA COMPARTMENT
G 91
P/NR. 131007
BEWARE OF INTAKE
ENTRIEGELN BEVOR DIE SCHLEPPSTANGE ANGESCHLOSSEN WIRD

FIAT G.91R/3 / *image by: Robert Kysela*

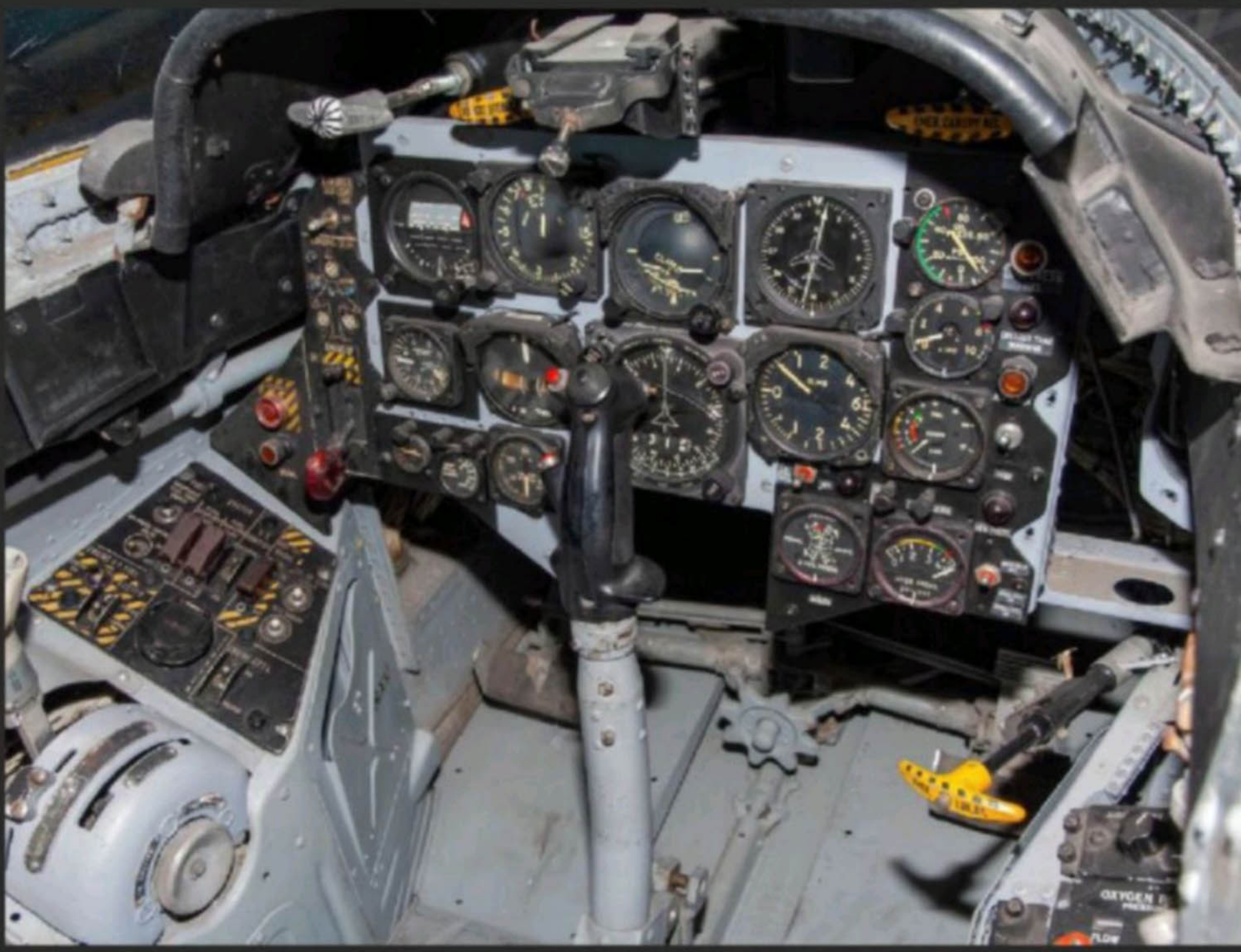
FIAT G.91R

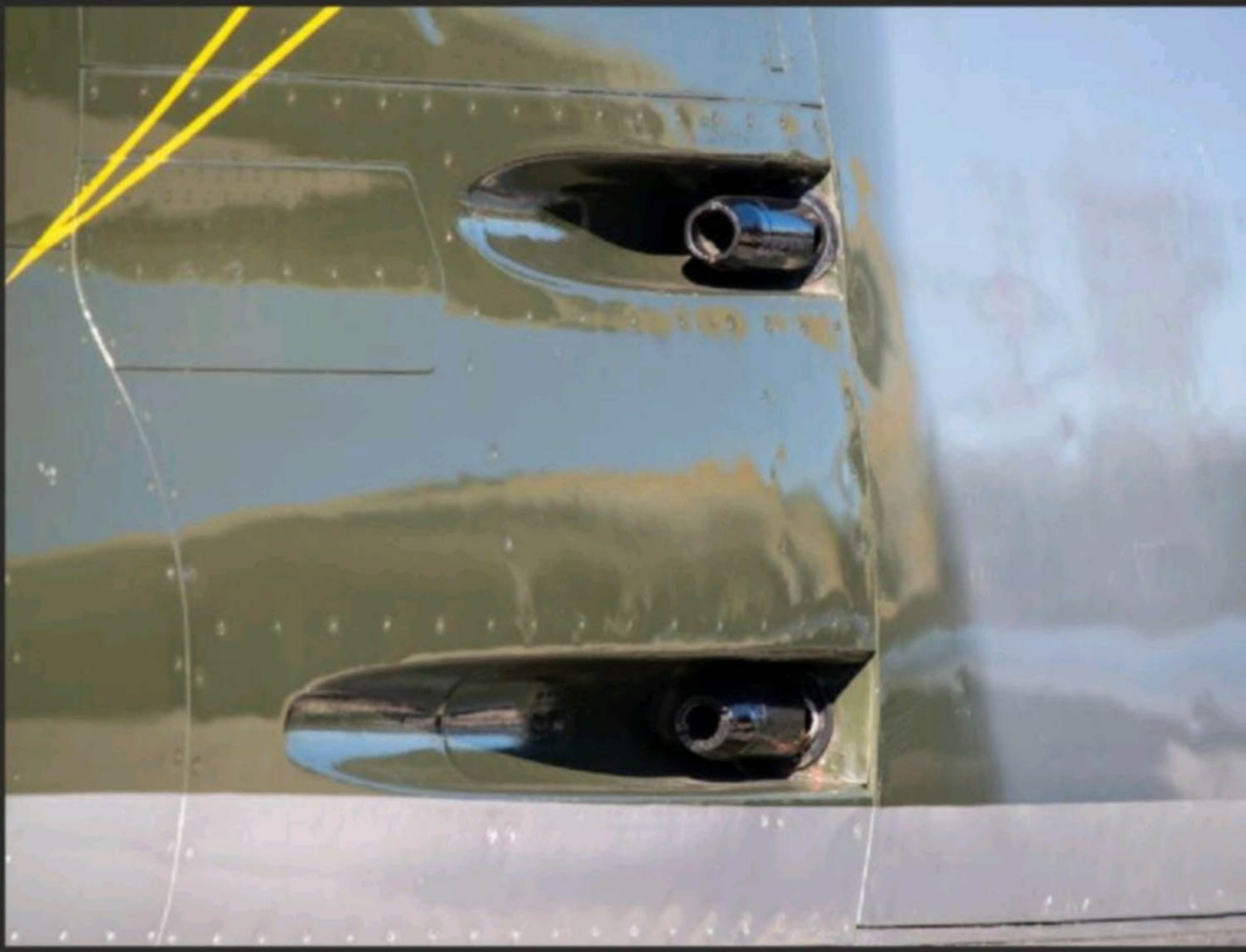
Shortly after the FIAT G.91 was officially selected as the winner of NATO's NBMR-1 competition, FIAT Aviazione commenced full-scale serial production of the aircraft. While prototype and pre-production models retained the simple designation G.91, the first operational variant was designated G.91R, with the "R" denoting Ricognizione (Italian for “reconnaissance”). This designation reflected its dual-role capability: not only was the aircraft configured for close air support (CAS), but it was also optimized for tactical photo-reconnaissance missions.

To support the reconnaissance role, the G.91R featured an internally mounted camera suite in the nose section, positioned above the air intake. Depending on the configuration, this included two or three vertical and oblique frame cameras (typically Vinten or OMERA units), enabling real-time battlefield imagery acquisition during operational sorties. This integration allowed the aircraft to conduct armed reconnaissance missions without sacrificing its primary attack capability, an important doctrinal advantage during the Cold War era. Multiple sub-variants of the G.91R were developed over time, primarily distinguished by differences in onboard avionics and armament fit. The initial production version, the G.91R/1, was equipped with four 12.7 mm Browning M3 heavy machine guns installed in the forward fuselage, two on each side. A total of 76 units of the R/1 were produced for the Aeronautica Militare Italiana (AMI).

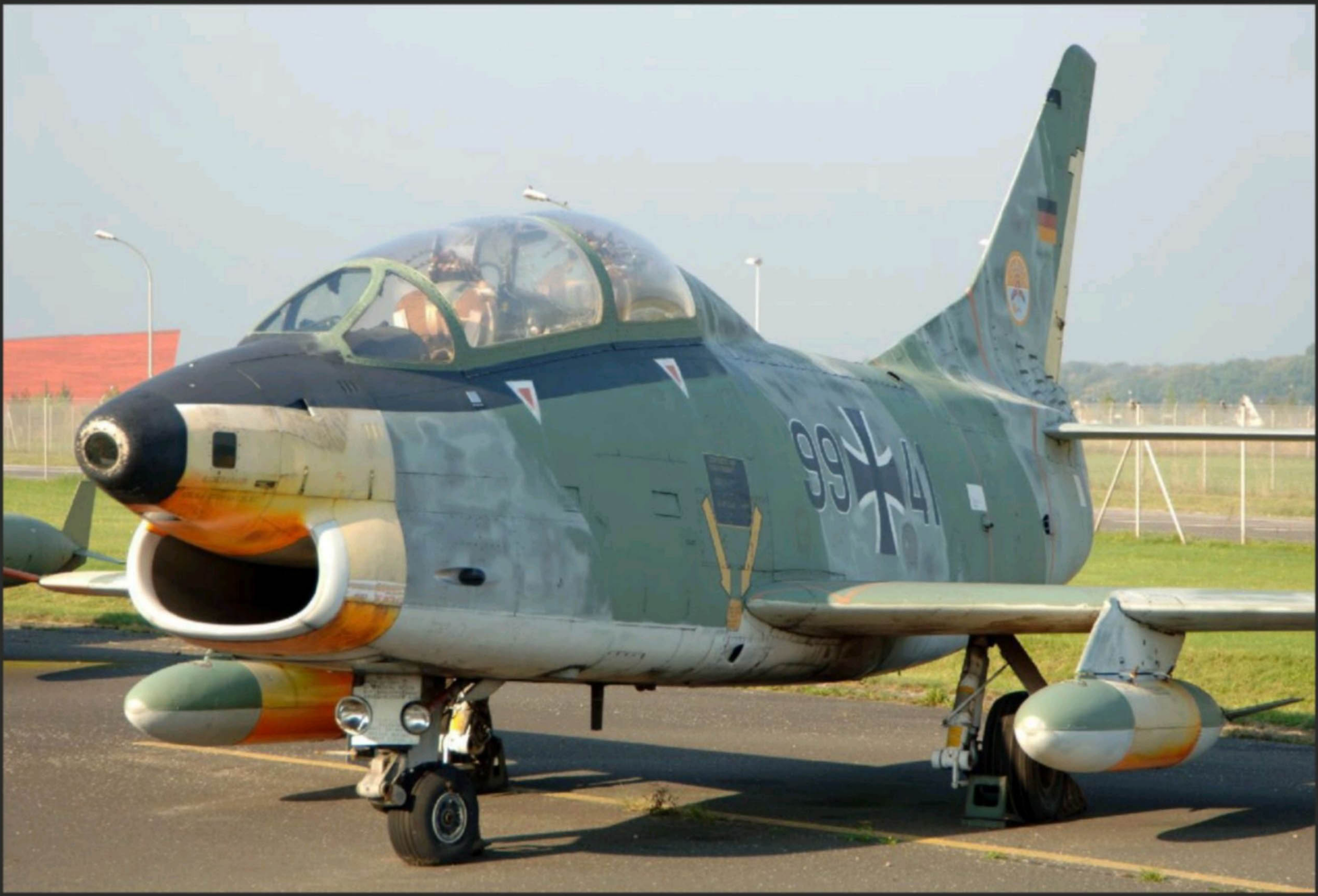
The largest export customer was the German Luftwaffe, which procured a total of 410 aircraft. Of these, 316 were manufactured under license by the ARGE Süd 91 industrial consortium, comprising Dornier, Heinkel, and Messerschmitt. The remaining 94 units (50 single-seaters and 44 dual-control trainers) were built by FIAT in Turin and delivered directly. Aircraft deliveries to Luftwaffe units commenced in 1961.

By the late 1970s, the Luftwaffe began phasing out the G.91 in favor of the Dornier Alpha Jet, a more modern multirole trainer and light attack aircraft. The last Luftwaffe G.91 was officially withdrawn from service by LeKG 43 on 30 July 1982. The German G.91R/3 and G.91T/3 variants featured several technical modifications compared to the Italian R/1 and R/4 models. Armament was upgraded to two 30 mm DEFA 552 revolver cannons, offering significantly higher kinetic energy and lethality than the original .50 caliber machine guns. Moreover, the German variant was fitted with four external hardpoints (versus two on the R/1), enabling a wider payload configuration for bombs, rockets, and external fuel tanks. The aircraft was also equipped with improved avionics, including NATO-standard navigation and communication systems, enhancing operational compatibility within alliance forces. These modifications were instrumental in adapting the G.91 to Luftwaffe doctrine and NATO’s tactical requirements during the Cold War.


Cockpit G.91R/3 / *image by: Robert Kysela*


FIAT G.91R/1 - Browning M3 / *image by: Robert Kysela*

FIAT G.91R/1 / *image by: Robert Kysela*



FIAT G.91T/3 - Luftwaffenmuseum Berlin Gatow / image by: Robert Kysela

G.91T Trainer

In addition to the single-seat ground attack variant, FIAT also developed a two-seat trainer version of the G.91. Primarily designed for instructional purposes, this variant was nonetheless fully capable of participating in combat operations. Based on the G.91R, the fuselage was extended by 1.40 meters to accommodate a second cockpit. The vertical stabilizer was redesigned and enlarged to compensate for the altered aerodynamic characteristics resulting from the longer fuselage.

Due to an increased empty weight of 3 865 kilograms (compared to 3 100 kilograms for the G.91R/3), the trainer variant had a slightly reduced top speed of 1 030 km/h, as opposed to 1 075 km/h in the G.91R/3. Despite this, the aircraft remained combat-capable. The main compromise lay in its armament: whereas the ground-attack versions were equipped with either two 30 mm DEFA cannons or four 12.7 mm Browning machine guns, the trainer was fitted with only two 12.7 mm MGs and featured just two underwing hardpoints.

Initially, the aircraft was equipped with the Martin-Baker MB Mk.4 ejection seat, later replaced by the MB Mk. GW6(A), which allowed for "zero-zero" ejection capability, that is, safe ejection at zero altitude and zero airspeed. The Italian Air Force (Aeronautica Militare) received the G.91T/1 variant, with 101 units produced by Fiat Aviazione. The German Luftwaffe, on the other hand, operated the upgraded G.91T/3, which featured NATO-standard navigation and communication systems. This enhanced equipment enabled significantly more accurate navigation and greatly improved training effectiveness. While the standard G.91 had relatively basic avionics, the T/3 version was specifically tailored to meet the Bundeswehr's operational requirements.

In total, the Luftwaffe received 66 aircraft. Of these, 44 were built directly by Fiat Aviazione, while the remaining 22 were manufactured under license by Dornier. An additional variant, the G.91T/3 LOGAIR, was used by civilian contractors, such as Condor Flugzieldarstellung GmbH, based in Nordholz, for aerial target simulation. For this role, the aircraft were demilitarized: their weapons systems were removed and replaced with modern target simulation gear, towing equipment, and optionally electronic countermeasures. In this configuration, the G.91T/3 LOGAIR remained in service until the end of 1999.

The G.91T played a crucial role in pilot training for both the Aeronautica Militare and the Luftwaffe. It enabled student pilots to train directly on the platform they would later operate operationally. Instrumentation and flight characteristics were largely identical to those of the single-seat version. Its robust design and versatility, capable of serving as a light fighter or ground-attack aircraft, made the G.91T a reliable and proven training asset in military aviation.

G.91Y ("YANKEE")

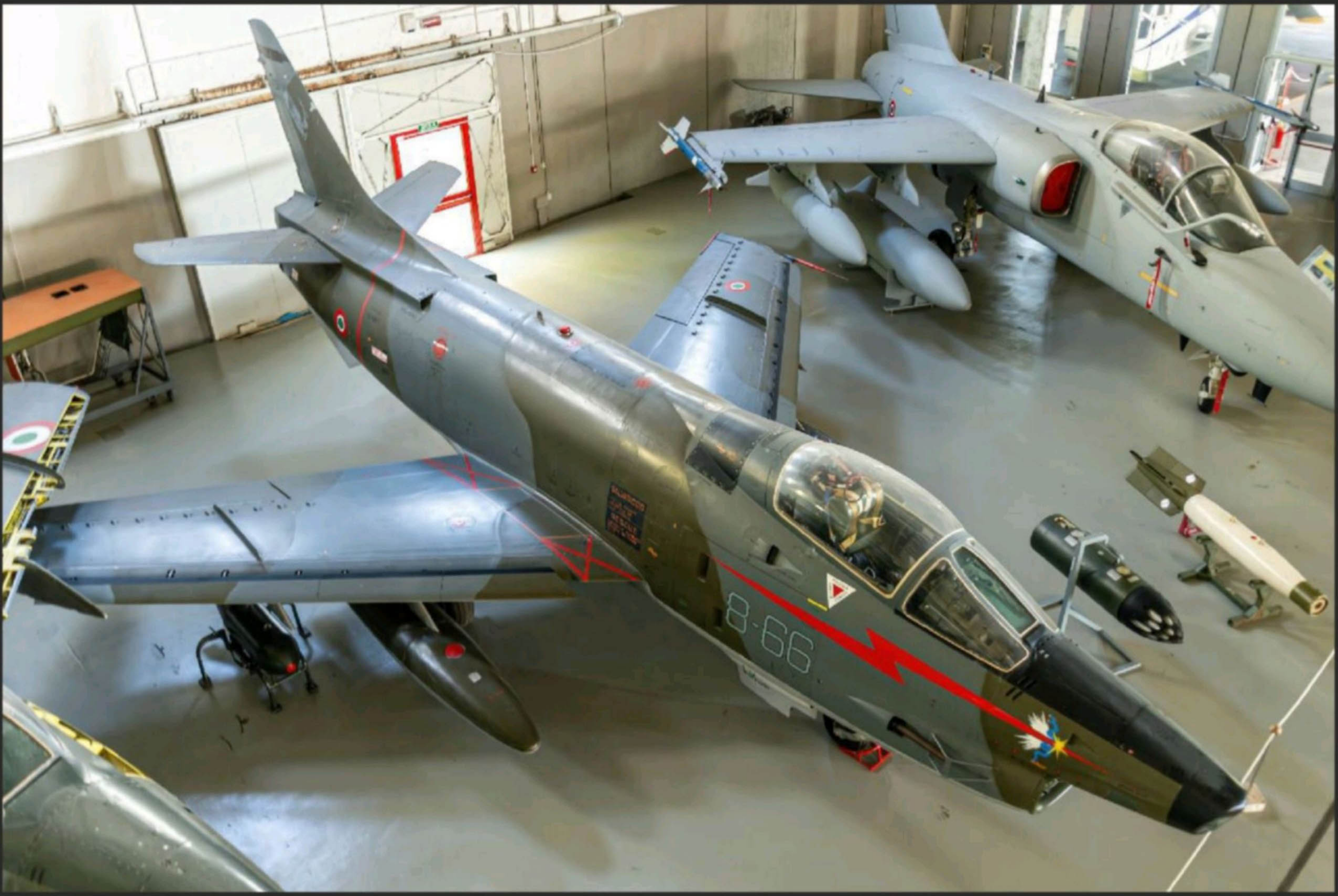
The G.91Y represented a significant evolution of the original G.91 design. Initiated by the Italian government in the mid-1960s, the program aimed to substantially enhance the aircraft's performance and broaden its operational capabilities. The starting point for development was the two-seat trainer variant, the G.91T.

The most critical upgrade was the replacement of the single Bristol Orpheus engine with two afterburning General Electric J85-GE-13A turbojets, each producing 18.15 kN of thrust in afterburner mode, which let to a 63% increase in total thrust compared to the original Orpheus-powered version. These engines were license-built by Alfa Romeo. The aircraft had an empty weight of 3 900 kg and a maximum takeoff weight of 8 500 kg. The G.91Y could reach a top speed of 1 100 km/h (approx. 580 knots or Mach 0.95 at 10 000 feet). The airframe was rated for +7/-3 g loads. The fuselage was aerodynamically refined, and the aircraft received new wings with a greater span and automatic leading-edge slats, significantly improving maneuverability. The G.91Y was equipped with modern avionics, including a gyroscopic platform, Doppler radar, a head-up display, and a gyro-stabilized gunsight.

The prototype's maiden flight took place on December 27, 1966. Following successful flight tests and the resolution of minor aerodynamic issues, such as repositioning the horizontal stabilizer to reduce vibration, serial production commenced. The first pre-production aircraft flew in July 1968. In total, 67 aircraft were built: two prototypes, 20 pre-production units, and 45 production models. Due to a lack of foreign orders, production ceased in mid-1976.

The FIAT G.91Y, nicknamed "YANKEE," was operated exclusively by the Aeronautica Militare. It entered service in 1970 with the 101° Gruppo/8° Stormo (Cervia–San Giorgio) and from 1974 onward with the 13° Gruppo/32° Stormo (Brindisi). The aircraft remained in active service until the early 1990s, when it was replaced by the Alenia AMX. No export sales were achieved, making the G.91Y a uniquely Italian aircraft. The G.91Y's primary mission profile was ground attack, with secondary roles in tactical battlefield reconnaissance. Thanks to its higher performance and extended range compared to its predecessors, it proved to be a more versatile and capable platform.

The FIAT G.91Y was the culmination of a focused development effort to build upon the success of the original G.91 series. It combined the operational flexibility of the baseline model with significantly enhanced performance and modern avionics. Although it saw service only in Italy and never achieved international success, it represented an important step in the postwar evolution of European combat aircraft and remained a vital asset to the Italian Air Force well into the 1990s.



FIAT G.91Y - Museo Storico Vigna di Valle / image by: Robert Kysela

Techn. Specs: FIAT G.91R/3

Length:	33 ft 8 in (10,26 m)
Height:	13 ft 6 in (4,13 m)
Wingspan:	28 ft 1 in (8,56 m)
Take-off weight:	14 330 lbs (6 500 kg)
Vmax.:	668 mph (1 075 km/h) Mach 0,86
Rate of climb:	7 450 ft/min (37,8 m/s)
Range:	621 nm (1 150 km)
Powerplant:	1 x Bristol Orpheus 803
Performance:	22,2 kN (5 000 lbf)
Armament:	2 x 30 mm DEFA 1814 kg on four hardpoints

NOTFALL
RESCUE
TO RELEASE CANOPY
ARMAMENT
32
72

FIAT G.91R/3 / image by: Robert Kysela

2
LUFTWAFFE-G91R/3-0542
BEWARE OF BLAST

FIAT G.91R/1A - "M.M.6305" - the only airworthy G.91

It was only two years ago that the Italian Air Force, the Aeronautica Militare Italiana (AMI), celebrated its centenary with a spectacular event at Pratica di Mare (June 16–18, 2023). For many attendees, the highlight of the air show was the breathtaking demonstration flight of the Lockheed F-104S Starfighter.

While there had been plenty of speculation in the lead-up to the event, few could have anticipated the appearance of a flying Fiat G.91 in the official program. The aircraft had been restored in record time specifically for this occasion. Remarkably, it completed its first post-restoration flight just two days before the centenary celebration, sporting the iconic livery of the Frecce Tricolori.

(Note from the editors: We featured a detailed report about this event in issue 3/2023.) The paint was so fresh that, in places, it had already begun to peel.

FIAT G.91R/1A / *image by: Danilo Bof*

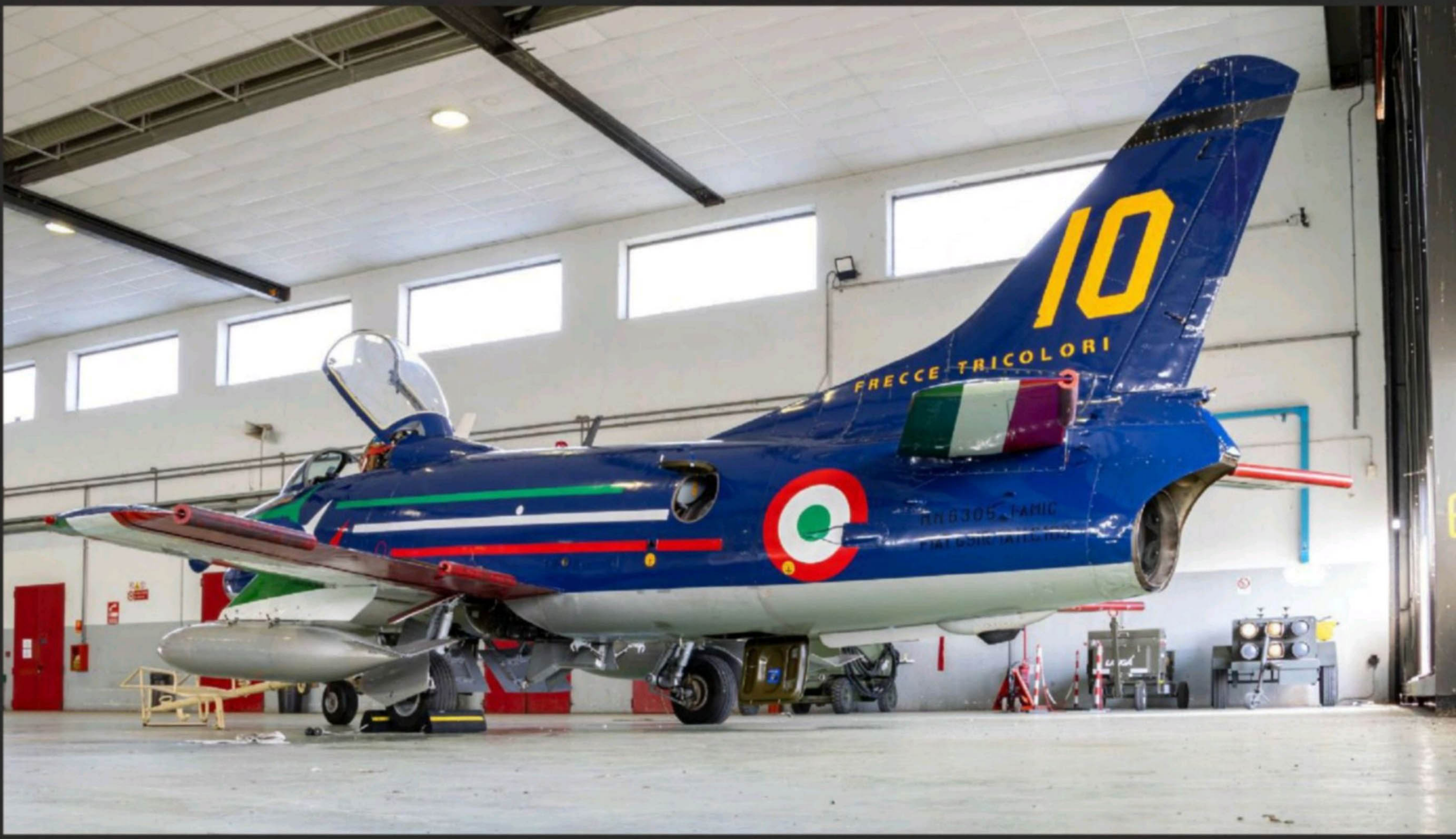
The G.91 Project

The aircraft restored for the centenary event is a FIAT G.91R/1, bearing the military serial number M.M.6305, and is part of the private collection of renowned entrepreneur Renzo Catellani. A native of Reggio Emilia, Catellani has made a name for himself through the recovery and meticulous restoration of historic Italian aircraft. His portfolio includes a two-seat Aermacchi MB-326 (I-RVEG) and a rare MB-326K (I-MBCK). In 2015, Catellani, through his organization VolaFenice (Callegari srl), successfully returned the world's only airworthy MB-326 to flight status. For this extraordinary achievement, he was awarded the prestigious Phoenix Diploma by the Fédération Aéronautique Internationale, recognizing it as the best vintage aircraft restoration of the year.
Catellani has never hidden his ambition to see a G.91 fly again, an endeavor that seemed nearly impossible at first. Most surviving examples had either been scrapped or stripped down and left to deteriorate as gate guards. His passion for aviation and his dedication to restoring historic aircraft have played a crucial role in preserving Italy's aviation heritage and bringing long-dormant machines back to life.

TThe G.91R/1 with serial number M.M.6305 was originally assigned to the Aeronautica Militare's 2° Stormo (2nd Wing), where it flew with 2-57 airframe code. After being retired in the early 1990s, the aircraft was placed on display at the Parco Velivoli Storici "Deltaland", a small open-air museum located in San Possidonio. Catellani acquired the aircraft in 2009 laying the groundwork for its full restoration. Official restoration work started in early 2022 and involved a comprehensive overhaul of all systems and structural components. The restoration team, made of Aeronautica Militare staff, and also several passionate people who cooperated in the endeavour, took care of the refurbishing of the fuselage, avionics, hydraulic systems, and the wings and the tail section. Different components have been replaced with parts recovered and restored from other G.91 due to damage or corrosion, while some parts have been rebuilt with the original specs from the 1960s.

One of the challenges was the modernization of outdated systems. For example, the original cartridge-based engine starter was replaced with a retrofitted pneumatic starter, improving reliability and maintainability.On June 14, 2023, the fully restored G.91 took to the skies once again from the Italian Air Force base at Piacenza. The flight was piloted by retired General Maurizio Lodovisi, a veteran test pilot with over 6 000 flight hours. This marked the first time in over 30 years that a G.91 had flown in Italian skies.

image by: Lt Col F. Dante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FRECCE TRICOLORI

FIAT G.91R/1 / *image by: Danilo Bof*

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FIAT G.91R/1

image by: Danilo Bof

Challenges

Since the original engine of aircraft M.M.6305 was no longer available, a replacement had to be sourced. The substitute powerplant was an Orpheus 803-K13, a variant that was originally standard in the G.91R/1B. To adapt it for installation in the G.91R/1A, a number of technical modifications were required, most notably the integration of an electrical control system to monitor turbine inlet temperature (JTPL). This system was obtained thanks to valuable contacts and the support of the Aeronautica Militare, who helped source the necessary components from other preserved aircraft.

Core Structural Components

At the heart of the aircraft lies the central load-bearing element: a precisely engineered fuselage-wing attachment block, which connects the wings to the main fuselage. Acquiring this critical part proved to be a significant challenge. Ultimately, the connection unit was salvaged from aircraft M.M.6272, marking a major breakthrough in the restoration project.

Support from the Malignani Institute

The Malignani Institute in Udine played a key role in the restoration. In addition to supplying a new tail section, wings, and control surfaces, the institute also provided elevators, landing gear, the cockpit canopy, the ejection seat, and various other components. These parts had previously been used by students for hands-on training in aeronautical engineering.

Technical and Structural Modifications

The engineering team was instrumental in returning the aircraft to airworthy condition, overcoming numerous technical challenges along the way. Among the key modifications carried out were:

- Installation of the electrical JTPL monitoring system
- Integration of ballast weights for demilitarization
- Installation of dual VHF/COM communication radios
- Installation of a transponder system with integrated GPS
- Installation of an emergency locator transmitter (ELT)

Thanks to the dedication and expertise of everyone involved, this challenging project was successfully completed. Like a phoenix rising from the ashes, the aircraft experienced a true rebirth.

The largest, and arguably most important, component in the cockpit is undoubtedly the ejection seat. The Martin-Baker MB Mk. GW6(A) was fully refurbished by SICAMB, one of the many companies contributing to the restoration. The story behind this ejection seat is particularly remarkable: the explosive charges for the Mk.6 model had to be imported from South Africa. This involved a complex and lengthy bureaucratic process, as the material, while demilitarized, remained classified as explosive.

cap. G.B. Molinaro

FIAT G.91R/1 / image by: Danilo Bof

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FIAT G.91R/1 / image by: Danilo Bof

FIAT G.91R/1 / image by: Danilo Bof

Energetic support

The goal of having the G.91 restored to flying condition in time for the Italian Air Force's 100th anniversary served as a powerful motivation for the entire team to meet the highest quality standards. Achieving this milestone required the support of numerous specialized companies, many of which had already been involved in the design or overhaul of components during the G.91's active service years. Among the key contributors were renowned firms such as Secondo Mona, ASE (formerly Magneti Marelli), Avio Electronics, Magnaghi, and AmpaSpace *PPG* srl (who restored the original canopy and was responsible for the incredible paint job) and many others. These companies not only brought decades of experience but also supplied original parts that were nearly impossible to source over 20 years after the aircraft had been retired. This extraordinary revival was also made possible through the active support of several Italian Air Force units, including the 3rd RMAA in Treviso, the 1st RMV in Cameri, personnel from the 6° Stormo in Ghedi, and the Association of Air Force Veterans (Associazione Arma Aeronautica).

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FIAT G91R/1A/TC.168

FIAT G.91R/1 / image by : Robert Kysela

One of the project's most important sponsors was the company ACS. Equally noteworthy was Leonardo S.p.A., which today represents a large portion of Italy's aerospace industry. Leonardo provided access to its historic archives, a contribution made possible by former employees of Fiat, Aeritalia, and Alenia. An endeavor of this scale could only be accomplished through close collaboration with Italy's civil aviation authority, ENAC (Ente Nazionale per l'Aviazione Civile). Three ENAC engineers and one pilot closely accompanied the restoration team, providing invaluable support especially in documentation and navigating the extensive regulatory and bureaucratic requirements central to a project of this nature. Yet, even after all these achievements, one critical step remained, and this is where the project's "trump card" came into play: General Maurizio Lodovisi. With the aircraft fully restored, it had to be flown again. The necessary procedures and paperwork were partially lost or no longer available, posing a major challenge. What followed were a series of tests, inspections, and a comprehensive technical commissioning process.

FIAT G.91R/1A / *image by: Danilo Bof*

FIAT G.91R/1A / *image by: Danilo Bof*

FIAT G.91R/1A / *image by: Danilo Bof*

Test flight in Piacenza

In February of this year, we received special permission from the Italian Air Force to attend a test flight of the G.91 at the Piacenza-San Damiano Air Base. Our correspondents, Danilo Bof and Emanuele Ferretti, seized this unique opportunity to add the proverbial "icing on the cake" to their report on the G.91!

The external walk-around began with the QTB (On-Board Technical Notebook), where all faults and deficiencies of the aircraft are meticulously documented. Next, the canopy jettison mechanism was inspected and tested. The lever for closing the landing gear doors in flight was then set to the proper position. Following that, the nose landing gear, with its anti-shimmy device, were carefully checked. This anti-shimmy mechanism prevents dangerous vibrations at critical speeds. Since the aircraft lacks Nose Wheel Steering (NWS), this check is especially important.

Subsequently, the avionics, air brakes, and rear landing gear were inspected, along with all control surfaces, rudder, ailerons, flaps, and more. A thorough inspection for leaks around the engine compartment followed. The effectiveness of all control surfaces was verified, and any red flags as well as the Pitot tube cover were removed. The QTB was signed off, and it was time to board. General Lodovisi donned his G-suit and climbed into the cockpit.

As mentioned earlier, the G.91R/1A no longer starts with an explosive cartridge; instead, it is powered up via a pneumatic starter. The unit was switched on, and after a few seconds, the distinctive whine of the engine echoed, signaling that the aircraft was ready for takeoff. A specialist assisted General Lodovisi with the pre-taxi checks, then removed the ladder and gave the pilot the go-ahead. The G.91's engine roared to life. After completing further checks, the brakes were released, and it was time to taxi to runway 12 at Piacenza-San Damiano Airport (ICAO code: LIMS). Conditions were ideal, and clearance for the test flight came from the tower.

This flight marked another crucial step toward certification and final approval. It was one of several test flights mandated by ENAC (Italy's Civil Aviation Authority) for the issuance of the final airworthiness certificate. After departing Piacenza, the aircraft headed toward Parma, where multiple touch-and-go maneuvers were performed. It then made a quick pass over Bologna before returning to Piacenza, all coordinated with civilian air traffic control.

Technically, the flight was designed to test the modifications made to the landing gear resulting from adapting new hardware to the older airframe. The correct deployment of the landing gear doors and the aircraft's behavior with the gear extended were carefully evaluated. The G.91 concluded the test flight by landing with its drag chute deployed.

1AFIAT G.91R/1A / image by: Danilo Bof

San Damiano Airport

The flight profile of the G.91 remains limited for the time being: Currently, the aircraft is restricted to a maximum load of 3 g, which rules out any aerobatic maneuvers. This limitation will be lifted once final certification is granted, even though, in practice, the aircraft will still not be pushed to its full structural limits in order to preserve its airworthiness for as long as possible.

The performance of the San Damiano airbase detachment is truly remarkable: The team is made up of highly skilled specialists, all of whom have prior experience with the G.91. Lieutenant Colonel Dante, the unit's commanding officer, has rightfully praised the outstanding dedication of his team. They brought to life a project that, back in 2021, few believed could ever be realized.

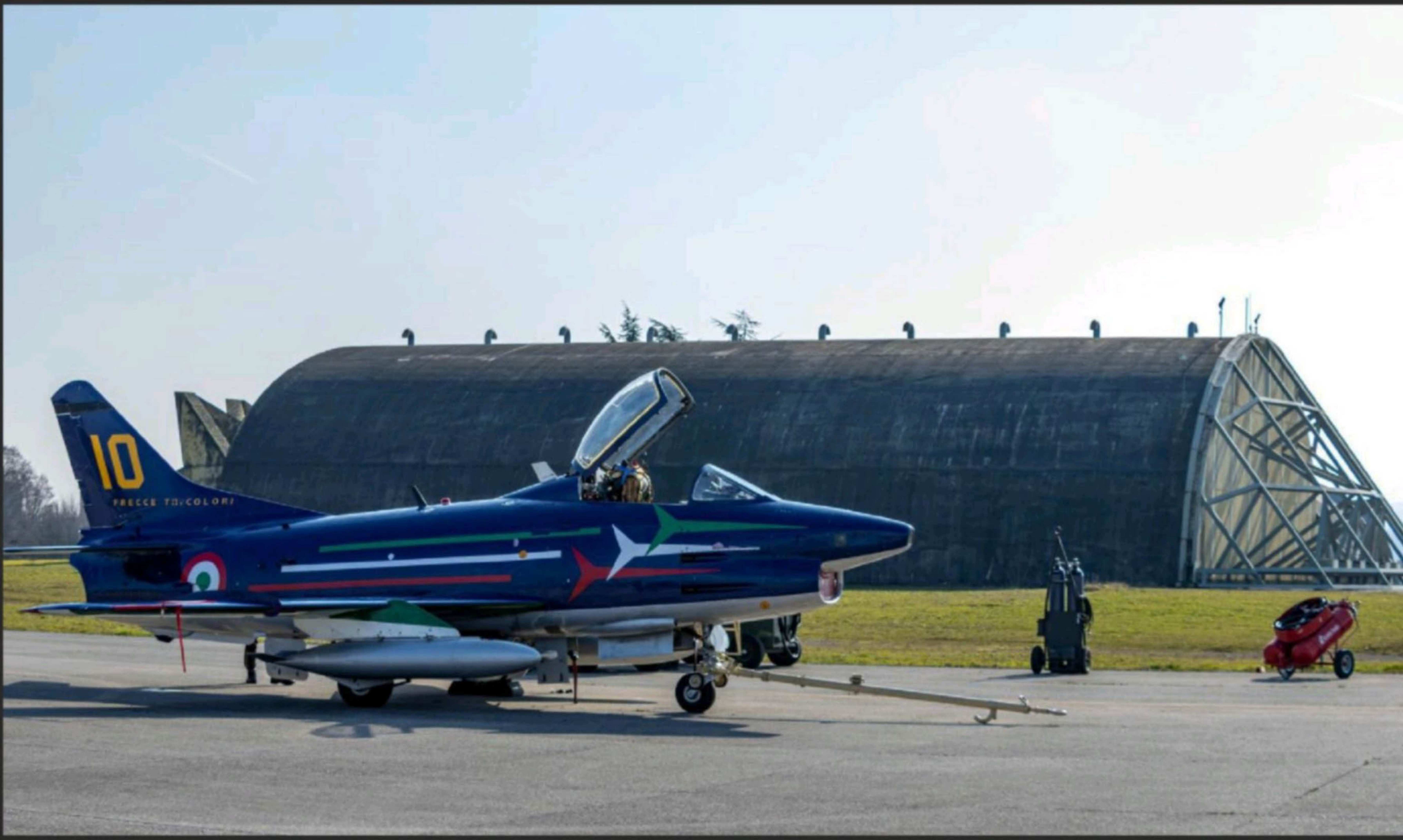
As previously mentioned, the restoration process was complex and often arduous, a path marked by setbacks, technical challenges, and bureaucratic hurdles. Obstacles that might have discouraged many. Yet thanks to the expertise and unwavering commitment of these professionals, the G.91 has not only taken to the skies for a one-time event but has also been prepared for sustained operational flight.

A brief but noteworthy side note: Out of the initiative launched in 2020, culminating in the Aeronautica Militare's centennial celebrations in 2023, and in which we had the honor of playing a pioneering role, a unique development emerged: The Italian Air Force has decided to establish a Flying Museum on the grounds of the San Damiano airbase.

This museum currently showcases several historic aircraft, including a Panavia TORNADO IDS featuring a special livery commemorating both the 70th anniversary of the 50° Stormo and the 65th anniversary of the 155° Gruppo (2006), the recently retired Alenia A-11 AMX (withdrawn from service in 2024), and an Agusta Bell AB 205, a license-built Italian version of the legendary Bell UH-1 "Huey."

With this, the Italian Air Force is making a clear statement: In addition to the renowned and absolutely worth-visiting museum at Vigna di Valle, a new, equally significant institution is taking shape. Its mission is the preservation of Italian military aircraft, ideally in flying condition, thus contributing meaningfully to the technical and cultural heritage of aviation.

FIAT G.91R/1A / image by: Danilo Bof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FRECCE TRICOLORI

FIAT G.91R/1 / *image by: Danilo Bof*

Interview: Gen (ret) Maurizio Lodovisi

CHK6: *"General Lodovisi, how did you become involved in this project?"*

General M. Lodovisi: *"My involvement with the G.91 I-AMIC project was the result of a unique, almost magical convergence, a blend of passion, dedication, love of aviation, experience, and a collaborative spirit. All of these came together with one goal in mind: to bring the legendary G.91, an icon of Italian aviation history, back into the skies.What many saw as nothing more than a rusty heap of scrap still held a dream for us, to take flight again and defy gravity, just like in its glorious past. Thanks to my fulfilling career in the Italian Air Force, culminating as a test pilot at the Experimental Flight Center, I had the privilege of flying nearly every military aircraft. This experience was the result of a lifelong devotion to flying, my true calling. It was this knowledge that I brought to the new challenges this project presented.A key factor was also the close collaboration with Renzo Catellani, the aircraft's owner, an avid pilot and friend. I'd already had the honor of flying several of his historic aircraft, including the Aermacchi MB-326 and the extremely rare, single-seat MB-326K, the only flyable example worldwide.None of this would have been possible without the unwavering support of the Italian Air Force. The foresight of Chief of Staff General Luca Goretti and his team was crucial. From the start, they recognized the historical and technical significance of the endeavor and supported it with intelligence, vision, and institutional sensitivity. But the true driving force behind the project was our extraordinary team. Engineers and technical specialists worked with remarkable professionalism, combining their technical expertise with a pioneering spirit, it was truly a stroke of luck. And we must not forget the ENAC certification team, whose professionalism, knowledge, and genuine enthusiasm played a vital role. Their commitment was a cornerstone of our success. This*

LODOVISI
cap. G.B. Molinaro

Maurizio Lodovisi / *image by: Robert Kysela* *project was a collective achievement, fueled by passion, expertise, and love of flight. A triumph not only for the aircraft but for teamwork. The support of various aviation companies who contributed their services pro bono was deeply moving."*

CHK6: *"Your role in the project's success has been widely recognized. Was there a particular phase during the restoration that moved you the most?"*

General M. Lodovisi: *"Absolutely. Every phase, from project planning and operational organization to solving technical challenges and navigating complex regulations and bureaucracy, was pioneering work unlike anything seen before in Italy. But the most emotionally charged moment was undoubtedly the final assembly of the aircraft. From what initially seemed like a chaotic pile of parts and components, a flyable aircraft gradually took shape. In that instant, the full significance of the project hit me. We originally dubbed the project, somewhat tongue-in-cheek, the "rising dream." Our approach was inspired by the famous American "Skunk Works" model: ambitious goals, firm deadlines, and relentless pursuit despite all obstacles. And that's exactly what we achieved."*

CHK6: *"What did you feel right before the aircraft took off for the first time?"*

General M. Lodovisi: *"It's hard to put into words, the mix of emotions was intense: excitement, tension, pride, and above all, the awareness that a seemingly impossible dream had been realized. As I prepared for takeoff, memories of the entire project flooded back, sleepless nights, seemingly insurmountable problems, endless meetings, tough negotiations, but also the faces of the people, their belief in the project, and their enthusiasm. Of course, I was nervous, anything else would be a lie. But that nervousness was grounded in deep respect. We all knew this was no ordinary takeoff. It was proof that a dream can come true. When the landing gear lifted off the ground, it literally choked me up. That simple technical act, lifting off,was the essence of the entire project: bringing something seemingly lost back to life. It marked the end of a long journey, and simultaneously a new beginning."*

CHK6: *"How meaningful was it for you to fly the G.91 during the 100th anniversary of the Aeronautica Militare?"*

General M. Lodovisi: *"Undoubtedly one of the most moving and significant moments of my career. It was not only a great honor but a deeply emotional experience. These flights embodied years of hard work and my gratitude to the Aeronautica Militare, an institution that represents an important part of our national identity. I felt like a part of its history, a history not only about technology and innovation but, above all, about people. These flights were a tribute to them all: the pioneers, the heroes, the technicians, and the silent contributors behind the scenes. I knew I wasn't just representing a technical project, but an ideal, a link between past, present, and future."*

CHK6: *"What does the future hold?"*

General M. Lodovisi: *"We are nearing the completion of the certification process, with over 20 successful test flights speaking for themselves. The G.91 has proven it is more than a museum piece. It is a living symbol that still inspires passion.Our goal now is to make this success visible, as a contribution to preserving heritage and inspiring new generations. Should I have the honour to continue flying the G.91, I will do so with the utmost respect, not for its own sake, but with a deep awareness of the significance behind every takeoff: a piece of history rising again, visible and inspiring. Of course, I understand the time will come to hand over the controls to younger pilots, a process already underway. But I will continue to support the project. Because even as one chapter closes, the legacy remains alive."*

CHK6: "General Lodovisi, thank you very much for this wonderful conversation!"

cap. G.B. Molinaro

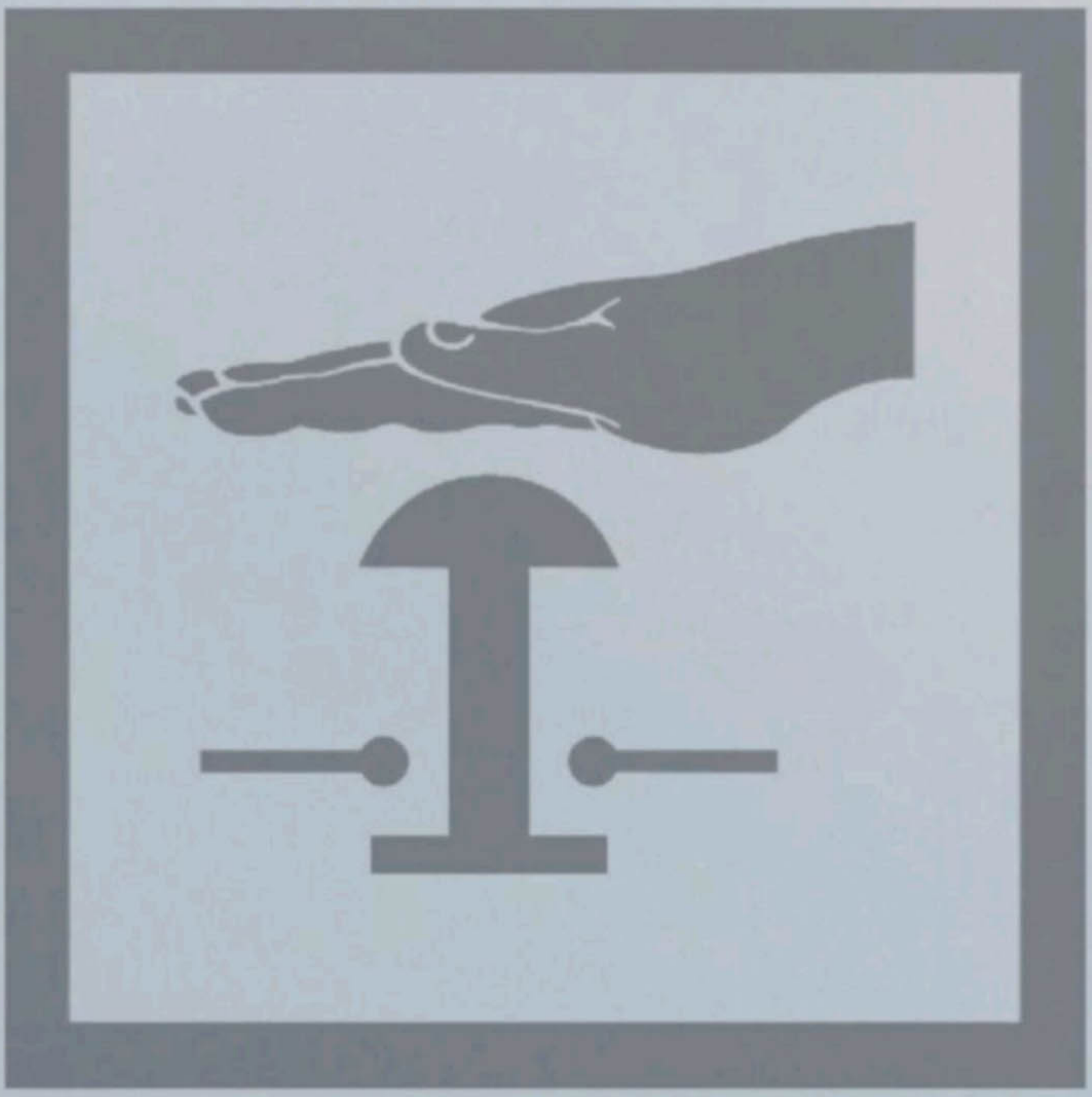
FIAT G.91R/1A / *image by : Robert Kysela*

The flight lasted only a few minutes, just long enough to complete the necessary checkpoints and to stir the hearts of everyone involved at the sight of this magnificent piece of aviation history taking to the skies.

After many years marked by challenges and repeated restoration efforts, the final return to flight operations of the FIAT G.91R/1A is now within reach. Although the G.91 was never produced in large numbers, it represents a significant chapter in the history of Italian aviation. No one truly believed they would ever see it fly again. Yet through an extraordinary collaboration between the military, industry, and a dedicated group of civilian supporters and specialists, the impossible has been made reality. To everyone who made this dream come true, we extend our deepest gratitude - *Grazie Mille!*

10
FRECCE TRICOLORI

KILL SWITCH
debate



WARNING - DO NOT CUT CANOPY
WITHIN 3 INCHES OF CANOPY FRAME
5164
Lt Col Jeffrey

Lockheed Martin F-35A LIGHTNING II / image by: Robert Kysela

We live in an age defined by an overwhelming and increasingly uncontrollable flood of information. The rise of social media has dramatically accelerated the spread of news, making it ever more difficult for individuals to process the sheer volume of content they encounter each day. One of the greatest challenges lies in distinguishing between factual reporting, deliberate misinformation, and mere personal opinion. The constant repetition and viral spread of so-called "fake news" make it especially difficult to combat such disinformation effectively.

This issue permeates nearly every aspect of modern life, aviation is no exception. A notable example is the ongoing debate surrounding the alleged existence of a "kill switch" in the F-35 LIGHTNING II, a fighter jet developed by U.S. defense contractor Lockheed Martin. According to speculation, this mechanism would allow the manufacturer or the U.S. government to remotely disable key systems if the aircraft's operator is no longer deemed an ally of the United States.

Story & images by: Robert Kysela

DANGER
EJECTION SEAT
RESCUE
TURN FWD MASTER LATCH
AND AFT MASTER LATCH
TO OPEN DOOR
DANGER
JET INTAKE
DANGER
63 FIGHTER SQ

Flying Computer

Several European countries have already taken delivery of the F-35, and others, including Germany and Switzerland, have also opted for the aircraft. Media-driven hysteria, both in traditional outlets and on social platforms, over a potential "kill switch" that could allow the U.S. government to remotely disable the F-35 LIGHTNING II, has sparked significant unease, not only among the general public, but also within political circles. Portugal became the first nation to cancel its planned procurement of F-35 fighter jets, citing a growing mistrust in the U.S. government's control over strategically vital defense systems. Since no binding contract had been signed at the time, the decision had no legal consequences. Other countries, however, such as Canada, which has ordered 88 Lockheed Martin F-35A aircraft to replace its aging fleet of McDonnell Douglas (now Boeing) CF-188 HORNETs, do not have such flexibility. A withdrawal at this stage would likely come with steep financial penalties.

What exactly is a “kill switch”, and how much truth is there to the current controversy?
In mechanical engineering, a kill switch is commonly known as an emergency stop, or “E-Stop” for short. It’s a safety feature designed to instantly shut down a machine or entire system in order to prevent injury or equipment damage.

Emergency stop switches are typically large, red buttons positioned in easily accessible areas on machinery or systems. While they were once purely mechanical devices, they are increasingly being supplemented, or even replaced by software-based solutions.

Digital kill switch systems are already in use across various industries. In the automotive sector, for instance, vehicle electronics can be remotely disabled in the event of theft. Modern diesel cars that rely on the additive AdBlue employ a similar mechanism: if the refill warning is ignored, a built-in software lock will eventually prevent the engine from restarting after a certain distance. In aviation, such systems are standard. Many aircraft models, both military and civilian, feature engine fire emergency switches that automatically cut off fuel supply and activate fire suppression systems in the event of an onboard blaze. The list of real-world applications for kill switch technology is long and continues to grow.

image by: Robert Kysela

Lockheed Martin F-35A

Lockheed Martin F-35A LIGHTNING II / *image by: Robert Kysela*

Lockheed Martin F-35B LIGHTNING II / image by: Robert Kysela

If it does exist, the kill switch could have serious implications for the combat readiness of any air force operating the Lockheed Martin F-35. Contrary to popular imagination, this isn't a physical switch hidden somewhere inside the aircraft. Instead, it's thought to be a software-based mechanism, comparable to a Trojan horse on a regular computer. In theory, it could be remotely triggered via an external signal at any time. What might actually happen in such a case remains speculative, but three possible scenarios are frequently discussed:

- **Limitation of avionics and sensors:**
  Certain avionics or sensor systems are either deactivated or significantly degraded in performance. This could trigger a cascade of error messages within the onboard systems, potentially grounding the aircraft or rendering it officially unfit for flight.
- **Deactivation of the weapons system:**
  The jet's weapons system may be entirely disabled or partially restricted, for example, by selectively blocking certain weapon types or mission-specific systems. This would severely compromise the aircraft's operational capability.
- **Worst-case scenario – manipulation of flight control:**
  In the most extreme case, the flight control software could be deliberately fed false data, causing the pilot to lose control. Such a scenario could, in the worst case, lead to a crash.

How could a kill switch make its way into a modern fighter jet? There are several plausible paths. One is through direct integration during the manufacturing process, where the mechanism is embedded in the original software. If done with sufficient skill and depth, it could remain hidden, even after hardware components are replaced. However, to stay functional, such a system would need to be updated or reprogrammed with every subsequent software update. In the case of the F-35, inserting a Trojan-style software tool would, at least in theory, be relatively straightforward. It could potentially be introduced anytime the aircraft is connected to a power source or its systems are booted up.

A key component of the F-35 is its bidirectional data link system known as ODIN (Operational Data Integrated Network). Through ODIN, every F-35 is connected to a highly secure, encrypted network that communicates in real time with servers in the United States. The system continuously collects, analyzes, and centrally stores a vast array of system data. ODIN offers undeniable benefits: it enables early detection of technical issues, automates spare parts ordering, optimizes maintenance schedules, and supports the long-term readiness of the fleet. However, it doesn't just transmit diagnostic information. Data on flight behavior and every single mission is also transmitted, officially for performance analysis and system improvement.

But the ODIN network does more than just collect diagnostics and performance data, it also enables remote software updates. These updates can be installed at any time and, if necessary, without the operator even being aware of it. This makes it largely irrelevant whether a kill switch or Trojan-style software was embedded in the aircraft at the time of delivery. Such features could be added or modified remotely at any point through the ODIN system quietly, and without detection. It's somewhat comparable to someone accessing your personal computer via a VPN, except in this case, the access happens without your consent and entirely beyond your control.

Creating or installing such a software function on the F-35 would require direct access to the aircraft's source code among all international customers of Lockheed Martin, none has been granted this level of access, except for one notable exception: Israel. The Israeli variant of the jet, designated the F-35I ADIR, was delivered with an open software architecture. This unique setup allows the Israeli Defense Forces (IDF) and local defense firms to make extensive changes to the software and even integrate their own proprietary systems. In doing so, Israel has secured an exceptional degree of independence in controlling and further developing the platform, an advantage no other F-35 operator has received.

So, does the F-35 have a kill switch, and are the concerns of its international operators justified?

The short answer: it's entirely plausible. Whether the mechanism is already embedded within the aircraft or exists as dormant software stored on U.S. government or manufacturer-controlled servers is, in practical terms, almost irrelevant. What matters is the technical feasibility of activating such a function at any time. That said, this scenario only becomes critical if a user nation is no longer seen as a trusted ally of the United States. Until then, the existence of such a mechanism, if it exists at all, remains a theoretical instrument of political influence rather than an operational threat.

Given this context, the current hype around the alleged kill switch seems difficult to justify. Anyone involved in the acquisition of such a sophisticated weapons system should have been fully aware of the inherent dependencies, especially when the platform in question is a U.S.-designed jet with an unparalleled level of digital integration, like the Lockheed Martin F-35 LIGHTNING II. The crucial point is this: we are talking about a purely software-based mechanism, one that could be introduced via a simple software update at any time. As a result, it's not just the F-35 that could potentially harbour a dormant kill switch. In theory, any modern combat aircraft with advanced digital infrastructure could be equally vulnerable.

Lockheed Martin F-35B LIGHTNING II / image by: Robert Kysela

Lockheed Martin F-35A LIGHTNING II / image by : Robert Kysela

Not only the F-35?

Naturally, Saab would not embed a kill switch in the JAS 39 GRIPEN operated by its own air force. But once the aircraft is exported abroad, even a Swedish fighter could, at least in theory, be fitted with such a capability. This highlights a key point: the suspicion that a software-based remote shutdown function could exist in a U.S. system like the F-35 is no less plausible than imagining similar possibilities in a European-built platform. But far more critical than speculation about kill switches is a hard operational reality: Any country that opts for a system like the F-35 must accept long-term dependence on the manufacturer and its supply chain, often for 50 years or more. Should that support ever be withdrawn, the combat readiness of the entire fleet would be in jeopardy. And this goes beyond hardware or spare parts, ongoing software updates are essential to keeping the platform functional. The F-35 relies on some 1 200 distinct software modules and applications to manage everything from flight control to weapon deployment, battlefield awareness, and secure communications. It is, in essence, a multirole fighter with a virtual second crew member, an onboard artificial intelligence that assists the pilot. What makes the F-35 so advanced is not the airframe itself, but its networked sensors and its seamless integration into a broader digital ecosystem of ground-based radar, airborne surveillance assets, and other friendly forces in the air and on the ground.

VT

Lockheed Martin F-35A LIGHTNING II / *image by: Robert Kysela*

Lockheed Martin F-35A LIGHTNING II / *image by: Robert Kysela*

Lockheed Martin F-35A LIGHTNING II / *image by: Robert Kysela*

Consequence

The risks of losing manufacturer support for a critical weapons platform became strikingly clear in the aftermath of the 1979 Islamic Revolution in Iran. Virtually overnight, the Iranian Air Force found itself unable to operate much of its cutting-edge fleet of Grumman F-14A TOMCATs, after the United States terminated all military cooperation. This included an immediate halt to the delivery of spare parts, technical manuals, and maintenance support. With no access to this essential infrastructure, Iran's ability to keep its F-14s airborne was severely compromised. Only through years of painstaking effort, and with the help of the country's domestic aviation industry, was Iran eventually able to partially restore operational capability. Spare parts were reverse-engineered, systems were replicated, and creative workarounds were developed to preserve what remained of the fleet.

Iran's ability to bring its F-14 TOMCATs back into service was due in large part to the relative simplicity of the technology used at the time. Compared to today's fifth-generation fighter jets, the systems in those legacy platforms were significantly less complex and more mechanically accessible. In contrast, modern combat aircraft are highly integrated systems in which hardware, software, sensors, and data connectivity form a tightly interwoven structure. For even the most advanced industrialized nations, achieving complete independence from the original equipment manufacturer (OEM) is virtually unthinkable. Ongoing access to OEM expertise, software updates, and spare parts is no longer optional, it is essential.

For buyers of foreign-developed weapons systems, a far more critical question than hypothetical control mechanisms is how the system's capabilities compare to those operated by the manufacturer's own armed forces. There is a long history of U.S.-built fighter aircraft being delivered to allied nations in downgraded configurations, often with reduced functionality in key operational areas. Such export practices were not uncommon in the past and were, in many cases, silently tolerated by the recipient countries.

For so-called premium U.S. partners, such as Israel, the United Kingdom, or most EU member states, the notion of receiving downgraded equipment is no longer acceptable. Participation in joint programs like the F-35 is not only expected to generate economic returns through industrial involvement, but also to ensure technological parity with the systems fielded by the U.S. Air Force.

In that light, the real question is not whether a kill switch might exist, but whether the aircraft delivered truly match the full capabilities of their U.S. counterparts.

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Lockheed Martin F-35A LIGHTNING II / image by: Robert Kysela

Conclusion

The F-35 doesn't require a kill switch to be effectively neutralized over time. The simple withdrawal of manufacturer support would be enough to severely impair the operational readiness of this highly sophisticated platform. In that respect, the current debate over a potential kill switch appears largely misplaced, if not a deliberate effort to undermine Lockheed Martin and its flagship aircraft. Who exactly launched this misinformation campaign, these fake news, remains unclear. But the question of who benefits from such narratives is one worth asking.

Far more relevant than speculative fears is a more fundamental concern: How do export variants of the F-35, such as those destined for Germany or Switzerland, compare to the jets flown by the U.S. Air Force? Are they truly equivalent in terms of capability and configuration? Realistically, only a seasoned test pilot with access to both versions under operational conditions could answer that question, someone able to detect subtle yet critical differences in avionics, sensors, and weapons integration, and interpret them with the required technical and tactical depth.

Robert Kysela

Sukhoi Su-30MKM (NATO Code: FLANKER-H) / image by: Shawn Clish

LIMA`25
LANGKAWI

The 17th Langkawi International Maritime & Aerospace Exhibition

The Langkawi International Maritime and Aerospace Exhibition (LIMA) 2025, held from 20-24 May, was the 17th edition of Southeast Asia's leading defence and aerospace event. Located on Langkawi Island, Malaysia, LIMA 2025 brought together key players from the maritime and aerospace sectors to present advanced technologies and encourage international partnerships. Under the theme "Innovate Today, Thrive Tomorrow," the event focused on innovation as a driver for industry development and regional security. The program featured aerial demonstrations by Royal Malaysian Air Force aircraft and international aerobatic teams, maritime simulations, and high-level forums within the exhibition hall, attracting a diverse array of global participants and visitors.

Story & all images by: Shawn Clish

TUDM
M52-10

Opening Gambit

The Langkawi International Maritime and Aerospace Exhibition (LIMA) 2025 marked a key milestone with increased participation and public interest. The event hosted 860 exhibitors from 24 countries, up from 600 exhibitors representing 30 countries in 2023, demonstrating its growing international reach despite a narrower country base. Public attendance surged to 450 000 visitors, nearly doubling from 250 000 previously, reflecting heightened regional enthusiasm for defence and aerospace developments. Over the course of the exhibition, LIMA facilitated around 1 400 business-to-business meetings and 920 business-to-government sessions, solidifying its role as a vital platform for networking and strategic partnerships within the global defence community.

The 2025 expo featured a wide range of activities, including equipment displays, flight demonstrations, forums, conferences, cultural exchanges, technology talks, and career fairs. Aerial displays were an obvious highlight, featuring fighters, airlifts and helicopters from the Royal Malaysian Air Force. While maritime presentations included prominent naval vessels such as the Royal Malaysian Navy's KD Lekiu (FFG 30) guided missile frigate, and Italian Navy's Antonio Marceglia (F597) frigate, underscoring the exhibition's dual focus on aerospace and maritime defence technology.

Since its inception in 1991, LIMA has grown into one of the largest maritime and aerospace exhibitions in the Asia-Pacific region. Held biennially in odd-numbered years, it attracts a diverse audience of defence officials, industry leaders, and enthusiasts. Over time, LIMA has expanded to cover both defence and commercial sectors, reflecting the evolving nature of these industries. Malaysia's strategic location in Southeast Asia, a region critical to global trade routes and security, has helped position LIMA as a key platform for showcasing innovation and fostering international cooperation.

Langkawi Island, known as the "Jewel of Kedah," offers a scenic and well-equipped setting for LIMA. Its pristine beaches, rainforests, and cultural landmarks like the Langkawi Sky Bridge and Panorama SkyCab attract visitors worldwide. The island's status as a UNESCO Global Geopark emphasizes its commitment to sustainability, while facilities such as the Mahsuri International Exhibition Centre (MIEC) and Resorts World Langkawi (RWL) provide modern infrastructure supporting the event's large scale.

The Malaysian Armed Forces, comprising the Army, Navy, and Air Force, have a combined strength of approximately 113 000 active personnel and 51 600 reserves. Their roles cover land defense, maritime security, and airspace sovereignty, working under the command of the Yang di-Pertuan Agong and strategic guidance from the Ministry of Defence.

Boeing F/A-18D HORNET / image by: Shawn Clish

Airbus A400M ATLAS / image by: Shawn Clish

The Royal Malaysian Air Force (RMAF) was a key presence at LIMA 2025 and stands at the heart of our coverage, in line with our focus on military aviation. As a cornerstone of Malaysia's national defence since its establishment in 1958, the RMAF fields a capable and diverse fleet, including the Boeing F/A-18D HORNET and the Sukhoi Su-30MKM (NATO code: FLANKER-H) - both renowned for their versatility and operational reliability. The RMAF is also in the process of modernizing, having entered into a significant defence agreement with Korea Aerospace Industries (KAI) to acquire eighteen FA-50 Block 20 GOLDEN EAGLE light combat aircraft. Valued at approximately USD 920 million (RM 4 billion), this deal was finalized in May 2023 during LIMA 2023.

The centrepiece of LIMA 2025 was its signature opening ceremony, the Opening Gambit, presented to an assembled delegation at the Mahsuri International Exhibition Centre (MIEC), located on the west side of Langkawi International Airport (WMKL), just south of the main passenger terminal. The official performance marked the formal start of the five-day showcase. It began promptly at 0830 on 20 May and was officiated by Prime Minister Datuk Seri Anwar Ibrahim. The event drew thousands of attendees, including international delegates, creating significant congestion throughout the area. Traffic was heavy, with swarms of scooters and motorcycles weaving through the roads, alongside police-escorted convoys that further added to the gridlock.

The aerial display began with a high-speed pass by a Boeing F/A-18D HORNET along Runway 21, releasing flares and compressing the humid air creating a significant amount of vapour around the jet. This was followed by an additional pair of HORNETS which also launched flares as they crossed to the east of show centre. The HORNETS gave way to a trio of Sukhoi Su-30MKMs and a tight six-ship formation of Pilatus PC-7 Mk.II turbo trainers. Unfortunately, the segment was missing the BAE Systems HAWK 208 (a combat variant of the successful Hawk trainer that features a single-seat and an air refuelling probe) after one of the jets veered off the runway due to a nose landing gear malfunction while attempting to land at Sultan Abdul Halim Airport in Alor Setar, Kedah during an opening gambit training exercise earlier in the week. The airlifters were next as a pair of Lockheed C-130H HERCULES (in training three aircraft had taken part), and two Airbus A400M ATLAS conducted passes from the east overhead. Finally, it was the helicopters taking the stage as two Airbus Helicopter EC725 CARACALS danced over the runway before joining a larger formation that included Leonardo AW139s and Airbus Helicopters EC120 COLIBRI. The finale saw twenty three of the twenty four aircraft fly in formation overhead from the east, while a lone HORNET flew low and fast in the opposite direction, releasing flares, providing an exclamation point to the Gambit, a true spectacle that showcased the skill and strength of the RMAF.

Airbuis Helicopters EC725 / *image by: Shawn Clish*

TUDM Flight Demonstrations

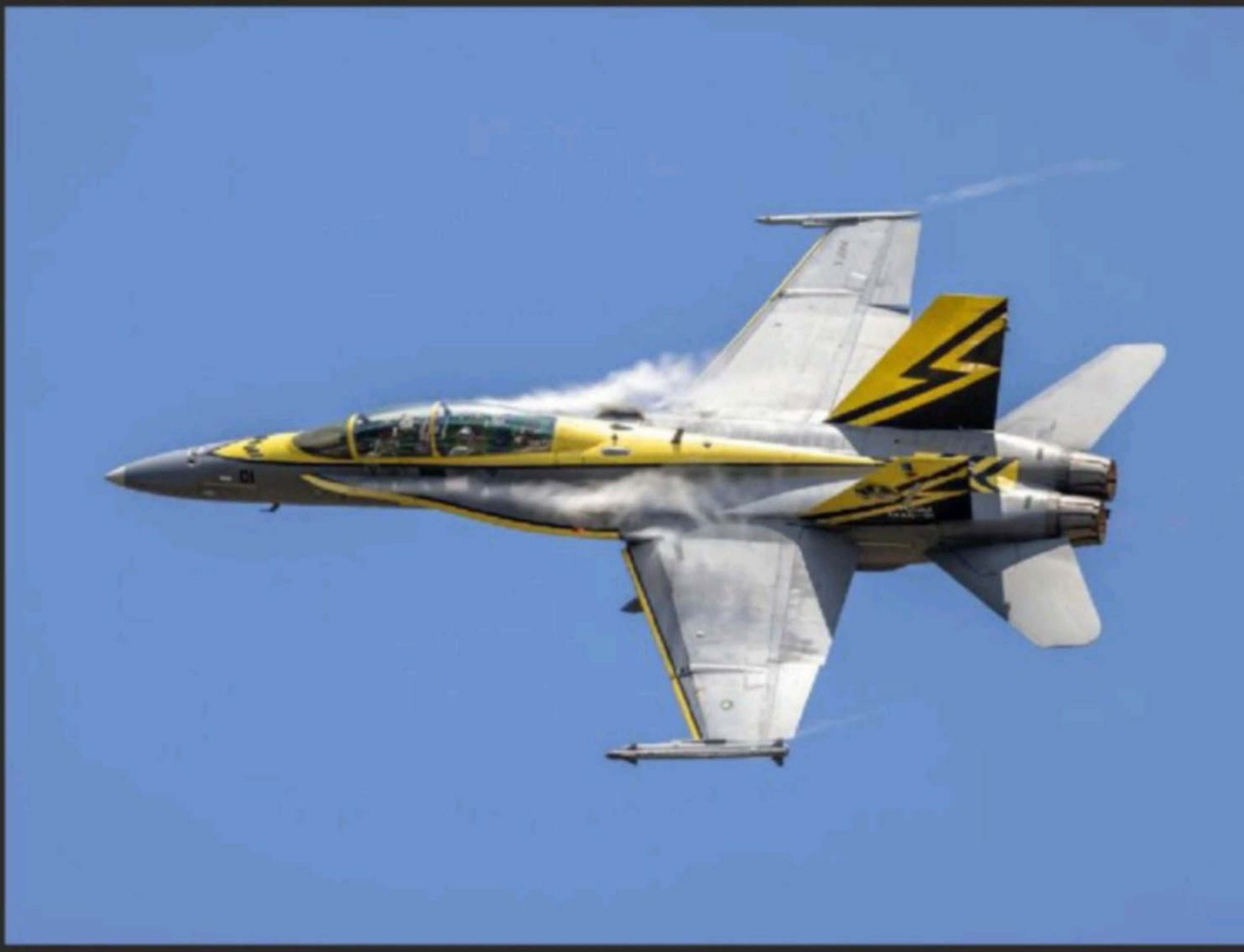
The Royal Malaysian Air Force (RMAF), locally known as Tentera Udara Diraja Malaysia (TUDM), is the aerial defense branch of Malaysia's armed forces. Its responsibilities include protecting national airspace, supporting land and naval operations, conducting surveillance and reconnaissance, and contributing to regional security and humanitarian missions. The RMAF operates a varied fleet combining Western and Russian aircraft technology to meet its defence requirements. At LIMA 2025, the RMAF demonstrated its capabilities through daily aerial displays featuring its main fighter jets, the Boeing F/A-18D HORNET and Sukhoi Su-30MKM, giving attendees a clear view of the skill and technology behind Malaysia's air defence.

The afternoon aerial demonstration at LIMA showcased the operational readiness of the RMAF's fighter fleet. The F/A-18D HORNET performed tight, precise maneuvers with dramatic flare releases, highlighting its agility and combat capability. The Su-30MKM complemented this with high-G maneuvers unique to the type, made possible by its thrust vectoring engine nozzles. The impressive display of energy management and raw power is highlighted by special maneuvers that see it dance and seemingly hover, or fall earthward such as during the tail slide. These daily displays of pilot expertise and fourth-generation fighter technology reinforced the RMAF's commitment to maintaining a modern and capable air force while engaging the public.

The Boeing F/A-18D HORNET is a core asset of the RMAF's No. 18 Squadron based at RMAF Butterworth, Penang. Delivered between 1997 and 2000, the eight twin-seat multirole fighters serve in air superiority, ground attack, reconnaissance, and maritime strike roles. Over the years, these aircraft have undergone upgrades to avionics, communications, and weapons systems, including the integration of the Joint Helmet Mounted Cueing System (JHMCS), Link 16 datalink and weapon systems, including AIM-9 Sidewinder, AIM-120 AMRAAM, Harpoon missiles, and precision-guided bombs. The Royal Malaysian Air Force (RMAF) is expected to finalize the acquisition of 30 used HORNETS from the Kuwaiti Air Force (KAF) in 2025. This purchase is intended to maintain Malaysia's air defence capabilities while awaiting the implementation of its Multi-Role Combat Aircraft (MRCA) program, projected to commence in the 15th Malaysia Plan around 2040. One notable HORNET, tail number M45-01, known as "Pikachu," features a distinctive yellow and black livery introduced in 2022 to mark 25 years of service, and was a crowd favourite at LIMA 2025 as part of the flying programme in the practice days leading up to the event and then in the static display once the show officially opened on 20 May.

TUDM
M45-02
02

Boeing F/A-18D HORNET / image by: Shawn Clish



Boeing F/A-18D HORNET / image by: Shawn Clish

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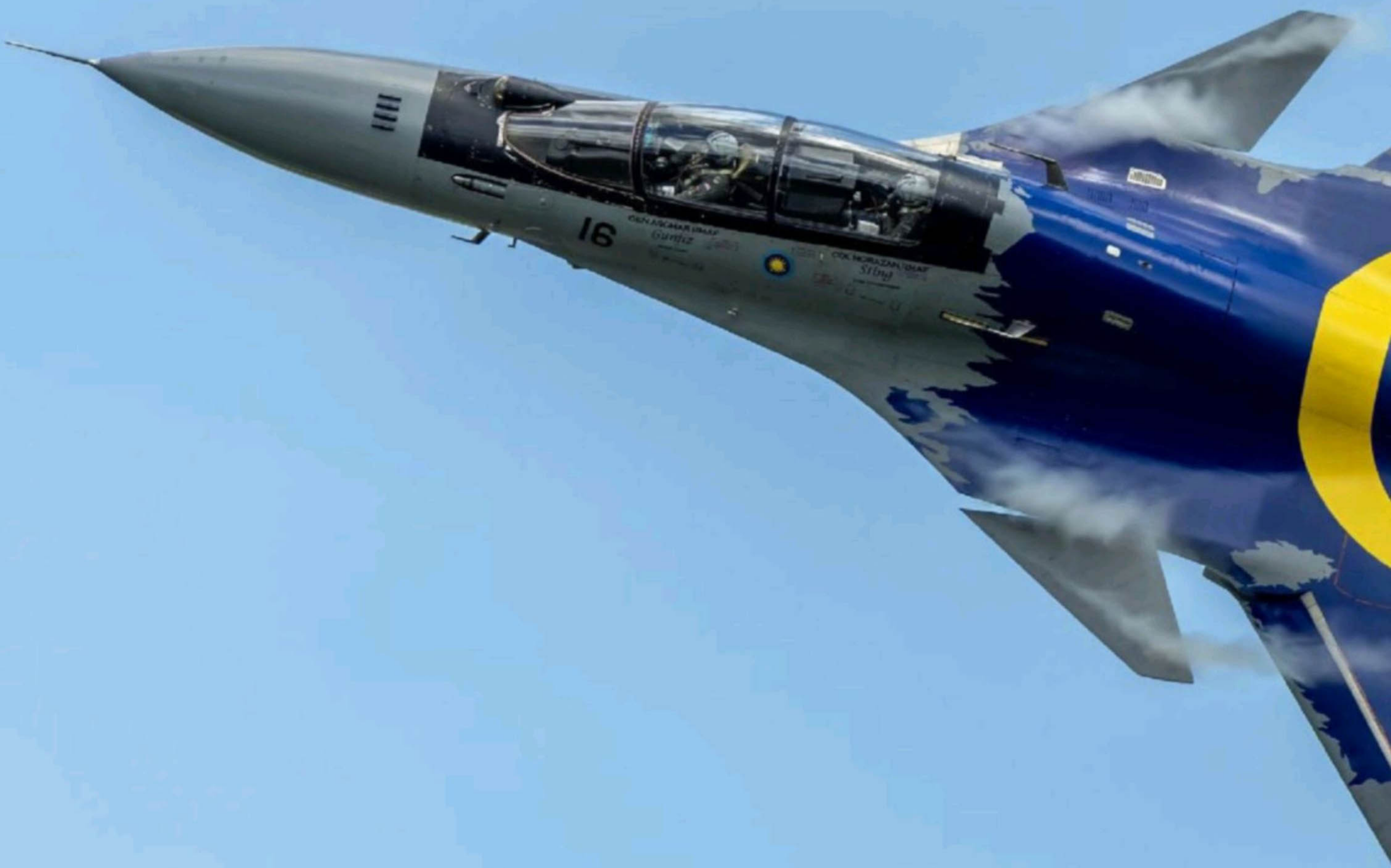
16

Sukhoi Su-30MKM (NATO Code: FLANKER-H) / image by: Shawn Clish

Malaysian Flankers

The Sukhoi Su-30MKM (NATO Code: FLANKER-H) forms the backbone of the RMAF's fighter fleet with 18 aircraft operated by No. 11 Squadron at RMAF Gong Kedak, Terengganu. Delivered between 2007 and 2009, the Su-30MKM is a customized variant of the Russian Su-30MKI, designed for long-range air superiority, deep strike and maritime attack. It features two powerful Saturn AL-31FP afterburning, thrust-vectoring turbofan engines, a N011M Bars radar, and electronic warfare systems from South Africa and France. Its armament includes R-77 air-to-air missiles, Kh-29 and Kh-31 anti-ship and anti-radiation missiles, guided bombs, and targeting pods. Despite maintenance challenges, local collaborations have enhanced serviceability. A standout in the fleet is the Su-30MKM with the "Jalur Gemilang" livery, nicknamed “Toruk Makto” (Rider of the Last Shadow) after creatures from the film Avatar, symbolizing strength and agility. This colourful aircraft was a pleasant addition to the flying programme, having only been completed in the weeks ahead of the show.



Sukhoi Su-30MKM (NATO Code: FLANKER-H) / image by : Shawn Clish

On the opening day, 20 May, Air Force Chief General Tan Sri Mohd Asghar Khan Goriman Khan made history as the first Air Force Chief to fly at a LIMA event. Piloting the "Toruk Makto" Su-30MKM with RMAF Gong Kedak Commander Colonel Mohd Norazan Othman as backseat pilot, the General performed a 12-minute demonstration featuring maneuvers unique to this aircraft. His participation reflected his dedication and the RMAF leadership's commitment to professionalism and excellence. General Mohd Asghar Khan, an experienced pilot since 1985, has flown the Douglas A-4 SKYHAWK, Northrop F-5E TIGER II, and Mikoyan Gurevich MiG-29N (NATO Code: FULCRUM) fighters during his career.

TUDM
TUDM
M52-16

Jupiter Aerobatic Team (JAT)

The JUPITER AEROBATIC TEAM (JAT) is the official aerobatic display team of the Indonesian Air Force (Tentara Nasional Indonesia – Angkatan Udara, TNI-AU). Founded in 1996, it initially flew eight BAE Systems HAWK Mk.53 aircraft from Skadron Udara 103, with its first public performance on September 23, 1997. In 2001, the team merged with Elang Biru to form JUPITER BLUE, but the group was disbanded after a fatal accident in 2002. The current JUPITER AEROBATIC TEAM was re-established in 2008, now flying six KAI KT-1B WOONGBI turboprop trainers. These planes feature a red and white livery representing the Indonesian flag, and are equipped with white smoke generators for their displays. The pilots are all flight instructors from TNI-AU.

Based at Adisutjipto International Airport in Yogyakarta under the 102nd Training Squadron (Skadron Pendidikan 102), the team's main role is to demonstrate the skill and precision of the Indonesian Air Force through aerobatic performances at airshows and public events. Their routines include tight formations, synchronized maneuvers, and dynamic aerial stunts, all performed with accuracy. These displays promote the capabilities of TNI-AU, foster national pride, and encourage young people to consider careers in aviation and aerospace.

Internationally, JAT has represented Indonesia at major airshows such as the Singapore Airshow, Langkawi International Maritime and Aerospace Exhibition, and events in Thailand and Brunei. Their participation emphasizes Indonesia's commitment to international cooperation and advancing its aerospace sector. Notably, at LIMA 2015, JAT performed a joint formation flight with South Korea's BLACK EAGLES, showcasing regional professionalism and camaraderie.

The team's name, "JUPITER" comes from the call sign used by Indonesian Air Force instructors, symbolizing leadership and excellence. The JUPITER AEROBATIC TEAM remains a source of national pride, highlighting Indonesia's aviation skills and promoting goodwill through its aerial performances.

The KAI KT-1B Woongbi is based on the South Korean KT-1 Woongbi turboprop trainer. In Indonesia, it serves both as a pilot training platform and a light attack aircraft. The type made its first flight in November 1991 and bears a strong resemblance to the Swiss Pilatus PC-7. However, thanks to its Pratt & Whitney PT6A-62 engine (708 kW / 950 hp), the KT-1B offers significantly more power, modern systems, and greater versatility compared to the PC-7.

Indonesia currently operates 20 aircraft of this type. In March 2025, the country signed a $64 million contract with Korea Aerospace Industries (KAI). Among other provisions, the agreement aims to extend the aircraft's airframe life by an impressive 150%, ensuring continued serviceability for years to come.

image by: Shawn Clish

Jupiter Aerobatic Team

10
15
18
JUPITERS
TNI AU

KAI KT-1B WOONGBI / *image by: Shawn Clish*

RUSSKIYE VITYAZI aerobatic team / image by: Shawn Clish

Russkiye Vityazi - Russian Knights

The RUSSIAN KNIGHTS, or "RUSSKIYE VITYAZI" in Russian language, are an elite aerobatic demonstration team of the Russian Air Force, known for their precise and thrilling aerial displays. Formed on April 5, 1991, at Kubinka Air Base near Moscow, the team originated from the 1st Aviation Squadron of the 234th Guards Proskurovsky Mixed Aviation Regiment. Initially flying three Sukhoi Su-27P (NATO Code: FLANKER B) seater and three Su-27UB trainer aircraft (NATO Code: FLANKER C), they gained early international recognition as the first Sowjet aerobatic team to perform outside the USSR during a 1991 tour of the United Kingdom.

Over time, the RUSSIAN KNIGHTS updated their fleet, transitioning to the Sukhoi Su-30SM (NATO Code: FLANKER-H) in 2016, a multirole fighter that enhanced their capabilities. By 2019-2020, they added the Sukhoi Su-35S (NATO Code: FLANKER-E), a modern fighter featuring advanced avionics, super maneuverability, and a thrust-vectoring system that allows post-stall maneuvers at low speeds. These aircraft enable the team to execute complex stunts such as synchronized barrel rolls, the Nesterov Loop, the Mirror, the Bell, and the Guardian Angel, all requiring precise timing and coordination.

At LIMA 2025, the RUSSIAN KNIGHTS faced a delay arriving in Langkawi due to a diplomatic issue: a neighboring country denied overflight clearance, forcing the team to adjust their route. They finally landed at Langkawi Airport on opening day at 9:20 a.m. Despite the late arrival, the team managed to perform by 2 p.m., delivering an impressive demonstration that highlighted their professionalism and ability to adapt under pressure.

The RUSSIAN KNIGHTS begin their display with two sections of three Su-35S fighters departing in quick succession. Once airborne, the full six-ship transitions into a series of tight formation maneuvers, including synchronized loops, barrel rolls, and slow-speed passes in “dirty” configuration, highlighting the aerodynamic precision and control of the aircraft. After the initial sequence, two aircraft break off and land, while the remaining four continue with more dynamic group aerobatics, such as line-abreast loops and tactical break turns. The formation then splits again and the pair of remaining aircraft execute maneuvers like the “mirror pass,” where one jet flies inverted above the other.

As the routine progresses, the formation reduces a final time to a solo aircraft. The solo segment features advanced post-stall maneuvers that take full advantage of the Su-35S's thrust-vectoring engines, including the famous Pugachev's Cobra.

РУССКИЕ ВИТЯЗИ

RUSSKIYE VITYAZI aerobatic team / image by: Shawn Clish

RUSSKIYE VITYAZI aerobatic team / image by: Shawn Clish

Sukhoi Su-35S - NATO Code: FLANKER-E / image by : Shawn Clish

РУССКИЕ ВИТЯЗИ

MD Helicopters MD 530G / image by: Shawn Clish

General Asghar Khan / image by: Shawn Clish

Delegation / image by: Shawn Clish

Static Display

The Malaysian Army Air Wing (Pasukan Udara Tentera Darat) showcased its rotary-wing strength with the AgustaWestland A109 light utility helicopter, one of the ten in the Army's inventory, and MD Helicopters MD 530G light attack helicopter, one of only six in the fleet. Malaysia obtained this next-generation armed scout-attack helicopter in 2016. The MD 530G is the latest version of the MD 500 DEFENDER series and is powered by a single Rolls-Royce 250-C30 engine,

The A109s, introduced in the mid-2000s, support reconnaissance and light transport missions, while the MD 530Gs, equipped with modern avionics and weapons systems, bolster the Army's close air support and rapid response capabilities. Both aircraft are sharply coloured in a four-tone digital camouflage pattern.

At the Langkawi International Maritime and Aerospace Exhibition (LIMA) 2025, Malaysia presented a comprehensive showcase of its defence and security capabilities across air and maritime domains. The Royal Malaysian Air Force (RMAF) highlighted its Sukhoi Su-30MKM multirole fighters and Boeing F/A-18D HORNETS. The Su-30MKM, a customized variant combining Russian airframe design with Western avionics, offers versatile capabilities in air superiority and ground attack missions. Meanwhile, the F/A-18D HORNET, a twin-seat, all-weather strike fighter, adds operational flexibility, particularly excelling in precision strike roles.

Maritime security and disaster response were underscored by the Malaysian Maritime Enforcement Agency (MMEA), which featured its Bombardier CL-415MP amphibious aircraft known for their effective water bombing in firefighting operations. These aircraft have played a vital role in battling forest fires in regions such as Sarawak and Selangor. With plans to retire the CL-415MPs by 2025, the MMEA is actively evaluating replacements capable of performing both maritime patrol and aerial firefighting, considering options like the Bombardier Dash 8-Q400 and Saab 340MSA.

Supporting these efforts, and the aerial demonstrations at LIMA 2025 as the emergency medevac option, was a Fire and Rescue Department of Malaysia (Jabatan Bomba dan Penyelamat Malaysia) Mil Mi-17-1V (NATO Code: HIP-H), located in a secured area of the apron adjacent to the static area. The fleet of four Mil Mi-17-1V heavy-lift helicopters are an export version of the Mil Mi-8AMT and are essential for disaster relief, SAR, and firefighting missions, often deploying Bambi buckets for aerial water drops. Their versatility was demonstrated through operations delivering critical supplies to remote communities and evacuating patients during emergencies, highlighting their indispensable role in Malaysia's emergency response framework.

Boeing AH-64D APACHE LONGBOW / image by: Shawn Clish

EMBRAER
KC-390
MILLENNIUM

Embraer KC-390 MILLENIUM / image by: Shawn Clish

Exhibition

The Mahsuri International Exhibition Centre (MIEC) once again served as the central venue for the Langkawi International Maritime and Aerospace Exhibition (LIMA) 2025, hosting a wide array of defence and commercial sector exhibitors. This year's edition welcomed 860 participating companies from 24 countries, an increase in exhibitors compared to the 600 companies from 30 nations at LIMA 2023. While the overall number of participating countries declined, reflecting shifting global priorities and tightening budgets, the exhibition maintained strong international engagement with more than 500 foreign delegations in attendance.

A notable shift in LIMA 2025 was the near-total absence of leading U.S. defence contractors such as Boeing, Lockheed Martin, and Raytheon, all of whom were significant participants in 2023. Their absence left a minimal U.S. footprint, subtly reshaping the event's competitive and international appeal. Stepping into this gap were emerging defence and aerospace manufacturers from Turkiye, China, Iran, South Korea, and India, who occupied prominent positions across the exhibition halls. Their presence underlined growing regional influence and deepening multilateral partnerships.

Malaysia's own defence and aerospace ecosystem was well represented by leading local firms such as Boustead Heavy Industries Corporation (BHIC), Deftech, Gading Group, Global Turbine Asia, NADI, Radimax, Sapura, System Consulting Services, and Zetro. Their participation demonstrated the country's continued push toward indigenous capability development and greater self-reliance in critical sectors.

International firms such as Airbus (UK), MBDA (France), Kongsberg (Norway), Naval Group (France), Korea Aerospace Industries (KAI), Aselsan, Roketsan, and Havelsan (Turkiye) also maintained a strong presence, reinforcing LIMA's relevance as a global defence and aerospace showcase. In parallel, a dedicated SME pavilion supported broader participation from both Malaysian and international small and medium enterprises, promoting innovation, industry growth, and workforce development.

A highlight of the week came on Wednesday, 21 May, when His Majesty Seri Paduka Baginda Yang di-Pertuan Agong Sultan Ibrahim ibni Almarhum Sultan Iskandar attended LIMA 2025. His Majesty arrived at 1015 a.m. and was received by Defence Minister YB Dato' Seri Mohamed Khaled bin Nordin, Chief of Defence Force General Datuk Hj Mohd Nizam bin Hj Jaffar, and Defence Ministry Secretary-General Datuk Lokman Hakim bin Ali.

CATIC
CATIC
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歼-10CE
POWER ON-A

Chengdu J-10CE (NATO Code: FIREBIRD) / image by: Shawn Clish

Sukhoi Su-57 (NATO Code: FELON) & Su-75 CHECKMATE / image by: Shawn Clish

Foreign Participation

Foreign assets were prominently featured among the static displays, with several standout aircraft drawing significant attention. One highlight was Brazil’s Embraer C-390 MILLENIUM, a versatile multi-mission military transport rapidly gaining international acclaim. With recent sales to Austria and the Netherlands and rising interest from countries like Sweden and Saudi Arabia, the C-390’s modern design, impressive speed, and substantial payload capacity are establishing it as a strong competitor to the long-established Lockheed Martin C-130 HERCULES.

Boeing F/A-18E SUPER HORNET / image by : Shawn Clish

The Republic of Singapore Air Force (RSAF), known for its advanced technology and strategic regional partnerships, made a significant contribution to the static exhibits. The RSAF showcased its powerful Boeing F-15SG STRIKE EAGLE, a specialized variant of the F-15E STRIKE EAGLE for the RSAF, equipped with cutting-edge avionics and weapon systems. Also on display was the Boeing AH-64D APACHE LONGBOW attack helicopter from the 120 Squadron, specialized in anti-armour and close air support roles. Completing the RSAF's lineup was the Boeing CH-47SD CHINOOK from the 127 Squadron, providing vital heavy-lift capability for troop transport and logistical support.

Maritime Segment

Prime Minister Datuk Seri Anwar Ibrahim officiated the Maritime Segment Gracing Ceremony at Resorts World Langkawi. The event commenced with a dramatic opening act featuring tactical divers from the Royal Malaysian Navy (RMN) and Royal Malaysia Police (PDRM) parachuting onto the main stage. The divers delivered a black box containing a symbolic slot card, which the Prime Minister activated to mark the official launch of the maritime program.
Following the ceremony, coordinated demonstrations showcased the capabilities of Malaysia's maritime enforcement agencies. The RMN led with high-speed maneuvers using its FCB 1326 and CB90 fast assault craft, performing crash stops and 360-degree turns. Air support included the Leonardo AW139, Westland SUPER LYNX Mk.100, and Eurocopter AS555 SN FENNEC helicopters. PASKAL, the RMN's special operations unit, executed a simulated hostage rescue by fast-roping from helicopters onto a mock hijacked vessel.

The Malaysian Maritime Enforcement Agency (MMEA) demonstrated its patrol and interception capabilities using 12-meter boats reaching speeds of 60 knots, supported by AW139 helicopters for aerial surveillance and rescue missions. PDRM's Marine Operations Force contributed Watercat M14-class boats, highlighting their rapid interdiction and coastal security functions.

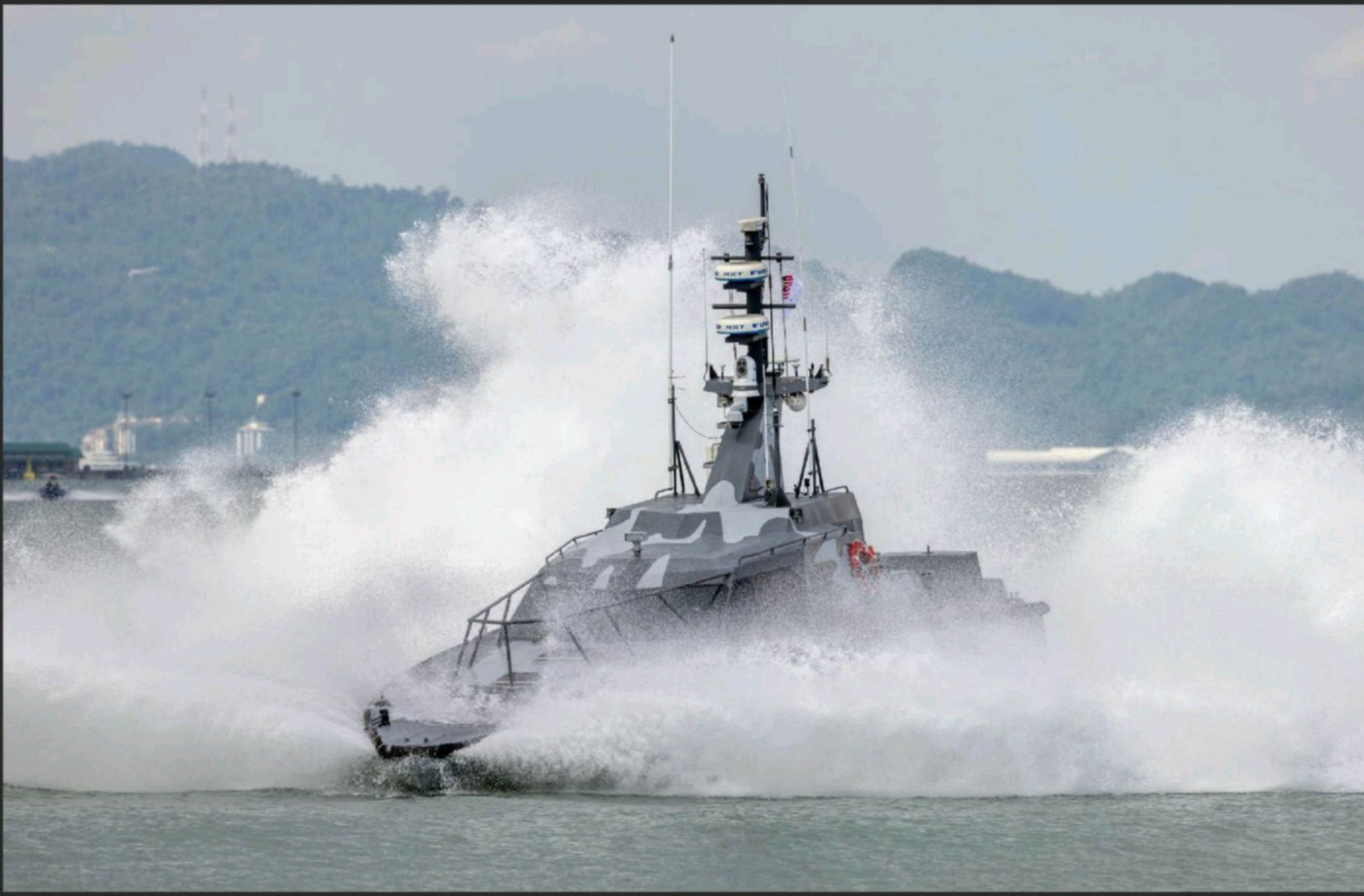
Additional agencies participated in a joint rescue and security simulation under the concept of an Inter-Agency Coordinated Rescue Mission. Units included PDRM's Marine Combat Unit (UNGERIN), the Customs Department's COBRA team, MMEA's STAR unit, and aerial and surface support from the Marine Department. Together, they executed a combined hostage rescue operation emphasizing tactical coordination across agencies.

The Fire and Rescue Department (JBPM) demonstrated maritime firefighting and casualty evacuation procedures using high-speed vessels and helicopters, while the Fisheries Department showcased its role in maritime resource protection. A Fly-Past and Sail-Past concluded the segment, with participating aircraft and vessels saluting dignitaries from the sea and air. Prime Minister Anwar then conducted a Fleet Review, a naval tradition involving inspection of ships at sea.

Also present for the opening ceremony were top government and military officials, including Navy Chief Admiral Datuk Dr Zulhelmy Ithnain, Deputy Navy Chief Vice-Admiral Datuk Shamsuddin Ludin, Defence Minister Datuk Seri Mohamed Khaled Nordin, Foreign Minister Datuk Seri Mohamad Hasan, and Chief of Defence Force General Datuk Mohd Nizam Jaffar. The demonstrations highlighted Malaysia's integrated maritime defense strategy and the operational readiness of its security agencies.

image by: Shawn Clish

AgustaWestland AW139



Malaysian Navy patrol boat (Combat boat 90) / *image by: Shawn Clish*

Airbus helicopters AS365N3 DAUPHIN / image by : Shawn Clish

M70-03
MARITIM
MALAYSIA
Perikanan

Conclusion

The LIMA 2025 expo concluded as a resounding success, reaffirming its stature as Southeast Asia's premier defence and aerospace exhibition. The airshow segment stood out with powerful flying displays by the Royal Malaysian Air Force's F/A-18D HORNETS and Su-30MKM FLANKERS, supported by international aerobatic performances from the Russian Knights and Indonesia's Jupiter Aerobatic Team. These aerial demonstrations not only captivated audiences but also reflected the technological sophistication and operational readiness of regional and global air forces. The maritime component was equally compelling, showcasing Malaysia's commitment to maritime security through dynamic live-action scenarios involving the Royal Malaysian Navy, the Malaysian Maritime Enforcement Agency, and other enforcement bodies. Coordinated exercises underscored inter-agency cooperation, tactical proficiency, and preparedness for maritime threats and humanitarian emergencies.
Meanwhile, the exhibition hall at the Mahsuri International Exhibition Centre hosted an extensive array of defence and commercial technologies, drawing industry leaders, government officials, and trade delegations from around the world. Although briefly overshadowed by the kinetic energy of the aerial and maritime displays, the exhibition played a vital role in advancing dialogue, technology transfer, and strategic partnerships.

In its 17th edition, LIMA proved once again that it is not merely a spectacle, but a vital regional hub for innovation, cooperation, and future-focused defence diplomacy. With increasing participation, expanded capabilities, and strong international engagement, LIMA 2025 has set a high bar for the future of defence and aerospace exhibitions in the Asia-Pacific region.

Shawn Clish

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Sukhoi Su-35S & Su-34 / image by: Robert Kysela

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5. Royal Int. Air Tattoo 2025 / RAF Fairford/UK
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7. ...

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